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Dev lopm nt of Series Concepts for Selected Soils in the Eastern Part of Land Resource Region M

Central Feed Grains and Livestock Region

Contents

Tables

Figures

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Development of Series Concepts For Selected Soils in the Eastern Part Of Land Resource Region M

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Introduction

As soil survey update activities begin to attain full stride, large areas may be recorrelated in short periods of time. These correlations will require homogeneous soil series, uniform soil interpretations, and presentation of data sufficiently precise to allow unanticipated interpretations. Series changes will be physiographic-province driven.

Soil scientists have always been excellent observers. They have in the past and still do see and record small differences in soil profiles. They have sampled many

istics of some series began to overlap significantly. Soil Taxonomy with its defined particle size classes was adopted by the National Cooperative Soil Survey (NCSS) in about 1968. This tended to cause all local and regional soil correlators to more carefully examine the particle size control section than other parts of the profile. In 1993, the series control section was extended to a depth of 150 cm or the base of a diagnostic horizon, whichever was more, not to exceed 200 cm. In most areas of Wisconsin-age till in LRR-M, a series depth limit of 150 cm includes some *unleached till.* Soils developed almost entirely in till have some unleached till at 100 cm or less. However, field soil scientists only needed to accommodate the particle size classes of the series. Commonly re as, the Williamstown series. The Kidder, Kidami, Miami, Miamian, Morley, and Ozaukee series are of primary interest. We use these six series to represent suites of soils that have at least part of their series control sections in the same till lobes. Approximately 50 soil series are directly involved in this investigation. Third, we provide data for possible refinement of series concepts. The areal extent of each series in the suite can be adjusted when similarity to its associated series is determined.

Background

In the first survey of Montgomery County, Ohio, all of the loamy soils developed over till were mapped as Miami (Dorsey and Coffey 1901). Five types were named ranging from sandy loam to clay loam, with clay loam being the most extensive. According to Simonson (1952) the concept of the soil series was developed by 1903. Miami was recognized as one of these series. "Prior to 1904, the Miami series (now restricted to fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs) had been mapped throughout a region which extended from Maine to Mississippi to Montana" (Simonson 1986).

Bailey (1978) published a brief history of the Miami series. He reported that the first standard description of the Miami series was prepared in Eaton County, Michi-

trol section until the list included all known possibilities. Eventually, almost all soils over till in a particular particle size class came to have overlapping properties. Each series thus became and remains difficult to separate using the control section of the official series description. As a result, series concepts and soil map unit components became broadly defined or were never developed. The irregular pattern of making soil surveys on a county basis encouraged an adjustment of official series descriptions to accommodate local conditions. Areal extent is not identified in the official series descriptions. Soil interpretations therefore sometimes range beyond class or even soil survey interpretation hazard limits. Once precise criteria for a series concept and its areal extent are determined, state and regional soil survey personnel can determine which suites of soils are appropriate and can then revise the official series descriptions. Soil interpretations can be adjusted as necessary to more accurately fit the map unit components.

Methods

Approximately 675 data sets are available for the six suites of soils (tables 1-11). The data from a variety of sources (Soil Survey Staff of Indiana 1977a, 1977b, 1979, 1980, 1981, 1982, 1983, 1984, 1986, and 1988; Soil Survey Staff 1967a, 1967b, 1968, 1970, 1980, and 1997; Smith and least the lower part of the series control section of each was formed in till. Thin loess overlies some of the pedons. Series therefore were placed in suites based on particle size distribution (PSD) and on the lobe of till each occurs in, rather than the name of the series shown in table 1. PSD is used in the till part of the series control section to avoid any possible loess influence. See figures 3 to 10 for the location and sample number of each data set. The sample numbers are listed with the data in tables 2 to 11. For example, the data sets for the Morley soil suite in the Lake Michigan Lobe (LML) are listed in tables 8 and 9 as Ozaukee soils. Field observations in the LML suggested that this suite has 50 percent or more silt in the till part of the series control section. The Ozaukee soil suite is representative. Therefore, all data sets for Morley and associated soils in the LML are included in the Ozaukee suite. As was mentioned earlier, six suites were created for study. If these six can be identified and located on maps, most of the other suites can be more easily studied in similar fashion.

A soil suite as defined herein consists of all soils on a particular lobe of till that have the same till in at least the lower part of their series control section. Variations occur in drainage class, organic matter, or parent material in the upper part of each suite of soils. Soil series occupying both metastable, degrading shoulders and metastable, aggrading footslopes are common on till plains. Many soils in such footslope positions have slope alluvium influences in the upper part and lacustrine deposits in the lower part. As a result, definition of an all-inclusive series concept is almost impossible.

Criteria that can be used to separate soil series in one suite from those in another are presented. Maps displaying the expected areal extent of each soil suite are also presented (figs. 4, 6, 8, and 10). The map scale is 1:1,000,000. A map of the five-state area is also included at a smaller scale (fig. 2). The larger scale maps have sufficient detail so that the areal extent of each till deposit can be determined with adequate accuracy for MLRA soil survey update activities.

Next we used the bulk density data for all B and C horizons of the soils to calculate the percent of pores drained and those filled at 1/3-bar water content on a whole soil basis. We also used the data to derive models for predicting bulk density data for the soils using particle size data as the independent variables. Clay content proved to be the most efficient independent variable. The model is listed as a footnote to tables 2, 4, 6, and 8 and was used to calculate bulk density data given in those tables. As would be expected, the calculated bulk density data for the six soil suites are the inverse of their clay contents, i.e. clay content of C horizons show Morley > Ozaukee > Kidami > Miami, whereas bulk density at 0.3 bar shows Miami > Kidami > Ozaukee > Morley. The derived data are not superior to clay content for differentiating between soils but should be useful for soil interpretations.

Results

The reliability of the five soil-forming factors as controllers of soil development was reinforced by the results of this investigation. In the study area, roughly the eastern Corn Belt, the soil temperature regime is mesic, the soil moisture regime is udic, and most landforms are geologically stable. Oak-hickory forests and tall grass prairies are the native vegetation. Of the 55 series included, only Hennepin and Wolcott do not have argillic horizons (table 12). All the soils formed at least in part in late Pleistocene till that is calcareous.

Areal extent

Particle size distribution analysis was especially useful for differentiation of all suites of till soils. A composite geology map (fig. 1) after Johnson (1986) and Fullerton (1986) was used to guide segregation of data points for analysis. This analysis was prompted by field observations of mapping crews, correlators, and research soil scientists. See tables 2 to 11 for a summary of data retrieved by soil series. STATSGO maps, redrafted to a 1:1,000,000 scale, were used to separate Wisconsin-age till areas from other parent materials. These maps (figs. 4, 6, 8, and 10) and the composite geology map were used to delineate areas of till deemed similar. Figure 2 is a composite of the state maps at a slightly larger scale than the geology map. Bulk density was also measured. Differences among series were significant in only a small number of cases, perhaps because the number of bulk density samples is small. Based on these observations and the data retrieved from the NSSL Database, areas of similarity were delineated. As one would expect, these areas coincided with lobes of till that have a common source. Thirteen suites were identified and their areal extent delineated (fig. 2). Only six were studied in detail. See figures 2, 4, 6, 8, and 10 for the locations of the various suites of soils studied.

Statistical analysis

Although over 650 pedons had been collected by universities and the national laboratory, many of the data sets were not complete enough for all purposes. Commonly, not all horizons were included. On the more complete data set of 69 pedons, we tested the maximum clay content of Bt horizons and thickness of overlying horizons as differentiae (table 13 and fig. 11). We used only pedons formed in till to avoid the impact of loess thickness on the depth to maximum clay. The pedons selected are from the till lobes and have the sand ratios chosen for the named series.

Only four of the series are included in table 13 because the numbers of pedons available for two others were too few for statistical significance. These two, Ozaukee and Kidder, however, plot on opposite ends of the array of pedons (fig. 11). The other four soils, Morley, Miamian, Miami, and Kidami, can be differentiated through use of maximum clay as a criterion. It seems that neither Ozaukee and Morley nor Kidami and Kidder can be differentiated through the maximum clay criterion. Depth to maximum clay in the same four series is only somewhat useful. By this criterion, however, Morley and Miamian can be differentiated from Miami and Kidami (table 13). Next we tested the parent materials for differences in the series because the parent materials are within the depth limits for soil series. Using either coarse sand (0.5 to 1.0 mm) or coarse plus very coarse sand (0.5 to 2.0 mm) of the parent material as a criterion, all of the soil series except Miami and Miamian can be differentiated (table 14).

Comparison of the maximum clay content of the argillic horizons with the carbonate-free clay contents of the till suggests that the parent material accounts for most of the clay that occurs in the Bt horizons (table 15). Thorp et al. (1959) had earlier concluded that much of the clay in the Miami Bt horizon was either unaltered or translocated from clay originally present. Our data from a wider range of till derived soils support this conclusion. Although 15-bar water data are not available for a few of the samples, we assume all the samples disperse well in the particle size analyses because the 15-bar water to clay ratios are < 0.6 for A, B, and C horizons that we have tested.

Soil properties

Experience guided the testing of soil properties, especially soil separates, for differences in the lobes of till shown on the geology map (fig. 1). For example, even without statistical analysis of the PSD, it is not difficult to note differences between the Lake Michigan Lobe (LML) Morley and the Huron-Erie Lobe (HEL) Morley. Both are in the fine particle size class. The former is silty to the touch, and the latter is gritty. A study of the data shows that the LML till has more than 50 percent silt. No other till in the study area has as much. It can be speculated that the Maquoketa Shale Formation, gouged out of the Lake Michigan basin, is the source of this soil separate.

Observed differences in interpretations were used to initiate the search for other differences in parent material. For example, the need for Kidami till areas to be separated from Kidder till areas is primarily one of perched water. The sandy loam Kidder areas usually do not perch water, while the sandy loam and loam Kidami areas usually do. More research is needed to identify key physical properties. However, our data show that the two series can be clearly differentiated by the coarse sand plus very coarse sand content of the parent materials (tables 14 and 16).

Statistical analysis of soil horizon data from more than 675 pedons in the NSSL Database verified differences in parent material (tables 14 and 16). These differences were obvious in some soil series, as in the textural differences between the Kidder and Morley soils. They were only indirectly observed by different interpretations between the Kidder and Kidami soils, which classify in the same fine-loamy family (table 12). Ozaukee, Morley, and Miamian soils also are in the same fine textural family so that soil scientists that had the opportunity to observe all three of soils could not differentiate among them based on clay content alone.

W. Hilton Johnson (1986) reports that the LML till differs from HEL till in the following ways. Dolomite content relative to calcite content of the < 74 micron fraction is higher, there is a greater abundance of illite in the clay fraction, garnet-epidote ratios are 2 or less in the fine sand fraction, and the LML till has lower magnetic susceptibility values. These properties could be used as series differentiae where necessary.

This study shows that the Ozaukee suite of soils can be used to replace the Morley suite of soils in the area occupied by the Lake Michigan Lobe (figs. 1 to 8). Ozaukee soils are classified as fine, illitic, mesic Oxyaquic Hapludalfs (table 12). Soils in this suite will have the following percentages of key soil properties in the till part of their control sections (table 16). Silt content is 50 percent or more. Clay content is 25 to 42 percent. Total sand content is 4 to 21 percent with 1 to 6.5 percent very fine sand and 2 to 7 percent of coarse sand plus very coarse sand. Rock fragment content is 1 to 5 percent. The data show that soils developed almost entirely in the till of this lobe have more than 50 percent silt throughout their sola. Moist (0.3 bar tension) bulk density of the <2 mm soil as calculated from the clay content is about 1.6 g cm^{-3} in the Cd horizon (table 8). Bulk density data for eight measured values for soil fragments at field moisture contents are higher (1.9 g cm^{-3}, table 9). Apparently the samples were below field capacity moisture contents when measured. The CCE ranges from 20 to 48 percent. Depth to the base of the argillic horizon is 50 to 100 cm. Field observations strongly suggest that these soils are Oxyaquic.

The Morley suite is located on the Huron-Erie Lobe (figs. 1, 2, 6, and 8). The Morley series is classified as fine, illitic, mesic Oxyaquic Hapludalfs (table 12). This study shows that soils in this suite will have the following percentages of key soil properties in the lower part of their series control sections (table 16). Silt content is 40 to 49 percent. Clay content is 27 to 42 percent. Total sand content is 17 to 30 percent. Very fine sand content is 1 to 7.5 percent. Coarse sand plus very coarse sand content is 2 to 8 percent. Rock fragment content is 3 to 37 percent. Calculated moist bulk density values of the <2 mm soil Cd horizons average 1.5 g cm^{-3} (table 6); values measured for the two samples available average 1.8 g cm^{-3} (table 7). The CCE ranges from 16 to 30 percent. Depth to the base of the argillic horizon is 50 to 120 cm.

The Miamian suite is located on the Miami and Scioto Sublobes of the Huron-Erie Lobe (figs. 1, 2, 6, and 10). The Miamian series is classified as fine, mixed, active, mesic Oxyaquic Hapludalfs (table 12). This study shows that soils in this suite have the following percentages of key soil properties in the till part of their series control sections (table 16). Silt content is 40 to 49 percent. Clay content is 12 to 27 percent. Total sand content is 24 to 45 percent. Very fine sand content is 6.5 to 9.9 percent. Coarse sand plus very coarse sand content is 6 to 13 percent. Rock fragment content is 8 to 18 percent. The CCE ranges from 36 to 45 percent. Depth to the base of the argillic horizon is 50 to 100 cm.

The Miami suite is located on the Huron-Erie Lobe and the East White Sublobe (figs. 1, 2, 6, and 8), table 12. This study shows that soils in this suite have the following percentages of key soil properties in the till part of their series control sections (table 16). Silt content is 23 to 50 percent. Clay content is 12 to 28 percent. Total sand content is 21 to 63 percent. Very fine sand content is 2 to 13 percent. Coarse sand plus very coarse sand content is 6 to 21 percent. Rock fragment content is 1 to 29 percent. The CCE ranges from 12 to 46 percent. The depth to the base of the argillic horizon is 60 to 100 cm. The calculated moist bulk density of the <2 mm soil is 1.8 g cm^{-3} (table 2) and somewhat lower than the average value measured for 19 samples, 1.9 g cm^{-3} (table 3).

The proposed Kidami suite is located on Lake Michigan Lobe till deposits (figs. 1, 2, 4, 6, and 8). The Kidami series is classified as fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs (table 12). This study shows that soils in this suite have the following percentages of key soil properties in the till part of their series control sections (table 16). Silt content is 33 to 48 percent. Clay content is 11 to 29 percent. Total sand content is 26 to 51 percent. Very fine sand content is 8 to 18 percent. Coarse sand plus very coarse sand content is 4 to 8 percent. Rock fragment content is 3 to 18 percent. The calcium carbonate equivalent ranges from 15 to 38 percent. The calculated moist bulk density of the <2 mm soil material in C horizons averages 1.79 g cm^{-3} (table 4), a value close to that of 1.83 g cm^{-3} measured for six C horizon samples (table 5).

The Kidder suite is located on the Lake Michigan Lobe (LML) (figs. 1, 2, 4, and 8). The Kidder soils are classified as fine-loamy, mixed, active, mesic Typic Hapludalfs (table 12). Almost all of the Kidder parent material is on the periphery of the lobe. All areas seem to have picked up properties from local rock formations after moving out of the Lake Michigan basin. The material contains more sand than any other till material studied. This study shows that soils in this suite have the following percentages of key soil properties in the till part of their series control sections (table 16). Silt content is 16 to 34 percent. Clay content is less than 10 percent. Total sand content is 58 to 77 percent. Very fine sand content is 11 to 20 percent. Coarse sand plus very coarse sand content is 10 to 18 percent. Rock fragment content is 5 to 30 percent. The CCE ranges from 21 to 62 percent.

Bulk densities as measured in the laboratory were too few and not sufficiently different to assist in separating any of the series. This phenomenon is especially apparent in the Ozaukee, Morley, and Miami soils, which appear to be layered, at least in the lower part. The CCE was not useful as series designator either. The CCE ranged widely in each of the till materials studied and thus always overlapped too much to be helpful. The CCE is probably different in each of them, and some probably do not overlap. Sampling error is the most likely cause of the wide ranges within the same till material. Small samples, plus lime accumulations, lime-coated rock fragments, and lime-containing rock fragments, not included in some samples and included in others, all contribute to the chances of collecting skewed samples.

Field evidence of soil development (B horizons) in the limy till was not described for most of the pedons. However, effervescence with dilute acid was enough to justify the B horizon designation. The preference for C horizon designations for calcareous materials is a habit from an old directive from regional correlators. See for example the description of till-derived soils in appendix IV of the Soil Survey Manual (Soil Survey Staff 1951). Study of the soil profile from a deep pit usually will reveal soil structure and some coats on faces of peds in the first limy horizon below the argillic horizon. In these places, depth to the base of the argillic horizon and depth to the base of the solum are not identical. It might be possible to find series differentiae in this horizon.

Other competing suites not studied

Alexandria and Amanda—For these soils, CCE might be helpful as series differentiae. The overlap with four of the suites is 4 percent or less. The data are limited, and therefore CCE only suggests an area for future investigation. There seems to be some hope for coarse sand plus very coarse sand of 8 percent or less being a possible criterion also.

Hickory—This series is thought to have formed in Illinoian-aged till. There should be an age-related soil property that can be described to separate this series from other till soils that are more than 100 cm to the base of the argillic horizon.

Hochheim—The base of the argillic horizon is at a depth of 50 cm or less. This is not true of other series in this suite, such as Theresa. The underlying till seems to be very similar to Kidami suite till. It could have the same description as Kidami, but occurs in the coldest part of the mesic temperature regime.

Mecan—This series has more than 70 percent sand in the lower part of the series control section. It can be separated from Hickory, Westville, Riddles, and Russell suites by percent sand in the argillic horizon and the till part of the control section. Soil temperature can be used also.

Riddles—This soil suite has layered till in much of the solum. It would be very helpful if the abrupt changes in the percentages of soil separates from horizon to horizon and the rapidity of changes with depth were more accurately described.

Waymor—These soils have glossic features.

Westville—These soils are thought to have formed in pre-Wisconsin till. They have 5YR or redder hues in their argillic horizons. None of the other suites of soils studied have hues this red.

Series differentia

Once the unique physical properties of each lobe of Wisconsin-aged till were known, the soils were separated on this basis. The data present in the National Soil Survey Laboratory Database were used to identify some of these definitive properties. A closer examination for other collateral properties would probably have revealed other differences as well. Properties that affect permeability were especially sought as differentiae. Visual observation and a relatively few bulk density and pore volume measurements (tables 3, 5, and 7), however, do not seem to be adequate to explain the differences that occur in the movement of water through these soils.

Previously, separation of similar soils, such as Alexandria, Miamian, Morley, and Ozaukee, was based on properties, such as color, mineralogy, and subclass. The same properties were used to separate the Amanda, Kidami, Kidder, and Miami suites of soils. These separations commonly were made to accommodate soil interpretations. Much of the time, suites of soils were not considered, and such series as St. Charles were mapped with a wide variety in the till part of the series control section.

Based on the findings of this study, the following statements can be used to separate suites of soils that have properties in the till part of their series control section similar to the series named below. Only one difference needs be noted for each series to justify its separation; however, the soil property named cannot overlap with the series separated. See table 16 for ranges in soil properties indicated by this research and for suggested parameters for separating each soil suite. The series named were selected to represent the soil suites.

Alexandria official series description

Competing Series—Morley and Ozaukee. Neither of these competing soils has >1 to 2 percent shale and sandstone fragments by weight in the till part of the series control section, so that the particle size analysis matches the field texture descriptions. None of the clay or sand measured by the PSDA is thought to come from shale or sandstone fragments in the till.

Amanda official series description

Competing Series—Kidder, Kidami, and Miami. The particle size of these competing soils is not significantly influenced by shale and sandstone fragments in the till part of their series control sections. Amounts of shale and sandstone are <1 to 2 percent by weight of the whole soil.

Kidami official series description

Competing Series—Amanda, Kidder, and Miami. Amanda soils have >1 to 2 percent shale and sandstone fragments by weight in the till part of the series control section. Kidder soils have less than 10 percent clay and more than 55 percent sand in the till part of the series control section. Miami soils have more than 8 percent coarse sand plus very coarse sand in the till part of the series control section.

Kidder official series description

Competing Series—Amanda and Kidami. Amanda soils have more than 10 percent clay and >1 to 2 percent shale and sandstone fragments by weight in the till part of the series control section. Kidami soils have more than 10 percent clay in the till part of the series control section. Also, Kidami soils have less than 55 percent sand in that part.

Miami official series description

Competing Series—Kidami. Kidami soils have 10 percent or less coarse sand plus very course sand in the till part of the series control section.

Morley official series description

Competing Series—Alexandria and Ozaukee. Alexandria soils have >1 to 2 percent shale and sandstone fragments by weight in the till part of the series control section. Ozaukee soils have 50 percent or more silt in the till part of the series control section.

Ozaukee official series description

Competing Series—Alexandria and Morley. Alexandria soils have >1 to 2 percent shale and sandstone fragments by weight in the till part of the series control section. Morley soils have less than 50 percent silt in the till part of the series control section.

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Appendix

Statistical equations derived for estimating properties of till soils. Variables in the equations are in volume percentage (%) for the whole soil (WS) at 0.3 bar. The WS coarse fraction (>2 mm fraction) is a percent by weight. The relationships are significant at a 99 percent confidence level.

Dependent variable		Equation
Pores drained	=	43.2% – 0.303 x WS clay content + 0.145 x WS sand content – 20.7 x WS Db at 0.3 bar, r^2 = 64.0, n = 94, SE = 2.0%
Pores filled	=	53.1% + 0.282 x WS clay content – 0.159 x WS sand content – 14.7 x WS bulk density at 0.3 bar, r^2 = 0.84, n = 94, SE = 2.1%
Ratio of drained to filled pores	=	1.37 – 0.00696 x WS coarse fraction % – 0.0180 x WS clay % – 0.399 x WS bulk density at 0.3 bar – 0.00648 x WS silt %, r^2 = 0.49, n = 94, SE = 0.091
Fine earth bulk density	=	2.04 - 0.0129 x clay % r^2 = 0.55, n = 110, SE = 0.11 g cm^{-3}

Tables

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Alexandria				
	1	PY-17	Pickaway	Ohio
Amanda				
	2	LC-24	Licking	Ohio
	3	LC-32	Licking	Ohio
	4	S58608-51	Morrow	Ohio
	5	PR-16	Perry	Ohio
Bennington				
	7	S87OH-041-001	Delaware	Ohio
	8	HU-10	Huron	Ohio
	9	HU-11	Huron	Ohio
	10	HU-12	Huron	Ohio
	11	HU-13	Huron	Ohio
	12	HU-14	Huron	Ohio
	13	HU-15	Huron	Ohio
	14	HU-16	Huron	Ohio
	15	HU-17	Huron	Ohio
	16	HU-18	Huron	Ohio
	17	HU-19	Huron	Ohio
	18	DL-16	Delaware	Ohio
	19	MD-20	Medina	Ohio
	20	FR-55	Franklin	Ohio
Birkbeck				
	21	PB-9	Preble	Ohio
	22	S78IL-103-005	Lee	Illinois
	23	S83IL-039-002	De Witt	Illinois
	24	S83IL-039-003	De Witt	Illinois
Blount				
	25	S48IL-197-003	Will	Illinois
	26	S48IL-197-006	Will	Illinois
	27	S48IL-197-007	Will	Illinois
	28	S68IL-43-002	Du Page	Illinois
	29	S80IL-53-002	Ford	Illinois
	30	S84IL-183-140	Vermilion	Illinois
	31	S84IL-39-011	De Witt	Illinois
	32	S84IL-39-014	De Witt	Illinois
	33	S84IL-39-035	De Witt	Illinois
	34	S84IL-39-036	De Witt	Illinois
	35	S84IL-39-046	De Witt	Illinois
	36	S86IL-113-002	McLean	Illinois

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Blount				
	37	S86IL-113-005	McLean	Illinois
	38	S86IL-113-053	McLean	Illinois
	39	S90IL-203-026	Woodford	Illinois
	40	S86IL-113-020	McLean	Illinois
	41	S81IN-053-003	Grant	Indiana
	42	S80IN-053-001	Grant	Indiana
	43	S89MI-026-004	Cass	Michigan
	44	S91MI-025-002	Calhoun	Michigan
	45	S84IN-179-001	Wells	Indiana
	46	S87IN-113-008	Noble	Indiana
	47	S87IN-113-006	Noble	Indiana
	48	S87IN-113-005	Noble	Indiana
	49	S87IN-113-004	Noble	Indiana
	50	S87IN-113-003	Noble	Indiana
	51	S83IN-075-001	Jay	Indiana
	52	S81IN-053-007	Grant	Indiana
	53	S84IN-035-001	Delaware	Indiana
	54	S79IN-001-000	Adams	Indiana
	55	HK-12	Hancock	Ohio
	56	S78IN-1-2	Adams	Indiana
	57	S84IN-179-001	Wells	Indiana
	58	DK-8	Darke	Ohio
	59	MW-15	Morrow	Ohio
	60	MR-7	Marion	Ohio
	61	MC-20	Mercer	Ohio
	62	S79IN-1-4	Adams	Indiana
	63	S80IN-1-5	Adams	Indiana
	64	S76IN-33-2	De Kalb	Indiana
	65	S74IN91-3	La Porte	Indiana
	66	S74IN-91-4	La Porte	Indiana
	67	S74IN-91-5	La Porte	Indiana
	68	S80IN-1-5	Adams	Indiana
	69	S80IN-49-9	Fulton	Indiana
	70	S79IN-69-2	Huntington	Indiana
	71	S79IN-1-4	Adams	Indiana
	72	S79IN-53-1	Grant	Indiana
	73	S79IN-75-7	Jay	Indiana
	74	S79IN-135-49	Randolph	Indiana
	75	S77IN-169-7	Wabash	Indiana
	76	S79IN-75-8	Jay	Indiana
	77	S78IN-9-3	Blackford	Indiana
	78	S77IN-69-1	Huntington	Indiana
	79	S78IN-135-21	Randolph	Indiana
	80	S77IN-53-1	Grant	Indiana
	81	S76IN-151-2	Steuben	Indiana
	82	S80IN-53-5	Grant	Indiana
	83	S80IN-183-1	Whitley	Indiana
	630	S55IN-3-14	Allen	Indiana
	631	S55IN-3-12	Allen	Indiana
	632	S55IN-3-11	Allen	Indiana

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Brookston				
	84	S84OH-037-031	Darke	Ohio
	85	S84OH-037-030	Darke	Ohio
	86	S68MI-045-001	Eaton	Michigan
	87	S93IN-039-007	Elkhart	Indiana
	88	S92IN-039-003	Elkhart	Indiana
	89	S75IN-23-11	Clinton	Indiana
	90	S75IN-23-12	Clinton	Indiana
	91	S76IN-31-4	Decatur	Indiana

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Chenoa				
	119	S86IL-105-023	Livingston	Illinois
	120	S86IL-105-026	Livingston	Illinois
	121	S87IL-113-069	McLean	Illinois
	122	S88IL-113-004	McLean	Illinois
	124	S89IL-113-008	McLean	Illinois
	125	S86IL-113-007	McLean	Illinois
	126	S86IL-113-008	McLean	Illinois
	127	S86IL-113-015	McLean	Illinois
	128	S87IL-113-048	McLean	Illinois
	129	S86IL-113-009	McLean	Illinois
	130	S86IL-113-022	McLean	Illinois
	131	S86IL-1 13-023	McLean	Illinois
	132	S87IL-113-076	McLean	Illinois
Condit				
	133	HU-17	Huron	Ohio
	134	CY-2	Cuyahoga	Ohio
	135	CR-20	Crawford	Ohio
Conover				
	136	S78AE-023-003	Branch	Michigan
	137	S76IN-23-1	Clinton	Indiana
	138	S79IN-73-30	Jasper	Indiana
	139	S78IN-33-11	De Kalb	Indiana
	140	S81IN-7-28	Benton	Indiana
Corwin				
	141	S83IL-183-040	Vermilion	Illinois
	142	S84IL-053-001	Ford	Illinois
	143	S87IL-113-022	McLean	Illinois
	144	S84IL-183-023	Vermilion	Illinois
	145	S84IL-183-032	Vermilion	Illinois
	146	S84IL-183-034	Vermilion	Illinois
	147	S78IN-73-10	Jasper	Indiana
	148	S80IN-7-11	Benton	Indiana
Crosby				
	161	S92OH-097-001	Madison	Ohio
	162	S84OH-031-033	Coshocton	Ohio
	163	S84OH-031-032	Coshocton	Ohio
	164	S81IN-053-008	Grant	Indiana
	165	S81IN-053-002	Grant	Indiana
	166	S92IN-035-015	Delaware	Indiana
	167	S91IN-035-001	Delaware	Indiana
	168	S75IN-23-8	Clinton	Indiana
	169	S75IN-23-9	Clinton	Indiana
	170	S78IN-65-7	Henry	Indiana
	171	S79IN-135-13	Randolph	Indiana
	172	S79IN-135-24	Randolph	Indiana
	173	S76IN-23-8	Clinton	Indiana
	174	S76IN-23-9	Clinton	Indiana

Continued

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Elliott Series				
	190	S48IL-197-001	Will	Illinois
	191	S83IL-053-004	Ford	Illinois
	192	S80IN-7-39	Benpon	Indiana
	193	S80IN-7-15	Benton	Indiana
	194	S84IL-183-27	Vermilion	Illinois
	195	S82IL-183-100	Vermilion	Illinois
	196	S84IL-183-23	Vermilion	Illinois
	197	S84IL-183-32	Vermilion	Illinois
	198	S84IL-183-34	Vermilion	Illinois
	199	S48IL-197-1	Will	Illinois
	200	S48IL-197-4	Will	Illinois
	201	S50II-197-1	Will	Illinois
	202	S76IL-19-9	Champaign	Illinois
	203	S77IL-10-30	Champaign	Illinois
	204	S77IL-75-1	Ford	Illinois
	205	S80IL-53-6	Ford	Illinois
	206	S84IL-147-9	Piatt	Illinois
	207	S84IL-183-24	Vermilion	Illinois

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Fincastle				
	236	S59IN-157-2	Tippecanoe	Indiana
	237	WW-7	Fayette	Indiana
	238	S70IN-5-4	Bartholomew	Indiana
	239	S68IN-11-5	Boone	Indiana
	240	S70IN-84-5	Vigo	Indiana
	241	S76IN-23-6	Clinton	Indiana
	242	S76IN-31-6	Decatur	Indiana
	243	S75IN-169-1	Wabash	Indiana
	244	S75IN-169-5	Wabash	Indiana
	245	S75IN-169-10	Wabash	Indiana
	246	S75IN-169-7	Wabash	Indiana
	247	S76IN-31-30	Decatur	Indiana
Flanagan				
	248	S81IL-115-033	Macon	Illinois
	249	S35IL-045-001	Edgar	Illinois
	250	S35IL-045-002	Edgar	Illinois
	251	S35IL-045-003	Edgar	Illinois
	252	S54IL-099-001	La Salle	Illinois
	253	S56IL-019-001	Champaign	Illinois
	254	S56IL-039-001	De Witt	Illinois
	255	S56IL-099-002	La Salle	Illinois
	256	S64IL-019-001	Champaign	Illinois
	257	S64IL-019-002	Champaign	Illinois
	258	S64IL-019-003	Champaign	Illinois
	259	S64IL-019-004	Champaign	Illinois
	260	S64IL-019-005	Champaign	Illinois
	261	S64IL-019-006	Champaign	Illinois
	262	S64IL-019-007	Champaign	Illinois
	263	S77IL-019-033	Champaign	Illinois
	264	S78IL-103-079	Lee	Illinois
	265	S81IL-115-020	Macon	Illinois
	266	S82IL-147-043	Piatt	Illinois
	267	S83IL-029-053	Coles	Illinois
	268	S83IL-029-095	Coles	Illinois
	269	S83IL-183-034	Vermilion	Illinois
	270	S85IL-011-024	Bureau	Illinois
	271	S90IL-203-005	Woodford	Illinois
	272	S90IL-203-022	Woodford	Illinois
	273	S82IL-183-054	Vermilion	Illinois
	274	S83IL-029-055	Coles	Illinois
	275	S83IL-029-071	Coles	Illinois
	276	S83IL-053-012	Ford	Illinois
	277	S81IL-115-016	Macon	Illinois

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Glynwood				
	279	S89MI-059-006	Hillsdale	Michigan
	280	S89MI-059-001	Hillsdale	Michigan
	281	S91MI-025-001	Calhoun	Michigan
	282	S87IN-113-007	Noble	Indiana
	283	S87IN-113-002	Noble	Indiana
	284	S87IN-113-001	Noble	Indiana
	285	S91IN-035-002	Delaware	Indiana
	286	S84IN-035-002	Delaware	Indiana
	287	S81IN-053-004	Grant	Indiana
	288	S79IN-135-39	Randolph	Indiana
	289	S79IN-135-48	Randolph	Indiana
	290	S78IN-1-3	Adams	Indiana
	292	S79IN-9-4	Blackford	Indiana
	293	S78IN-33-8	De Kalb	Indiana
	294	S78IN-135-17	Randolph	Indiana
	295	S80IN-1-2	Adams	Indiana
	296	S79IN-69-1	Huntington	Indiana
	297	S80IN-75-11	Jay	Indiana
	298	S80IN-75-12	Jay	Indiana
	299	S80IN-183-4	Whitley	Indiana
	300	S91MI-25-001	Calhoun	Michigan
	301	SH-15	Shelby	Ohio
	302	MW-16	Morrow	Ohio
	303	AG-8	Auglaize	Ohio
	304	S80IN-1-2	Adams	Indiana
	305	S78IN-1-3	Adams	Indiana
	306	S79IN-1-6	Adams	Indiana
	648	SS13023-SS130025	Hancock	Ohio
Graymont				
	307	S90IL-203-052	Woodford	Illinois
Hayden				
	308	S92MN-131-12	Rice	Minnesota
Hennepin, Lewisburg, Strawn				
	309	S83IL-183-023	Vermilion	Illinois
	310	S82IL-143-020	Peoria	Illinois
	311	S88IL-113-027	McLean	Illinois
	312	S79IN-135-31	Randolph	Indiana
	313	S79IN-135-32	Randolph	Indiana
	314	S80IN-135-55	Randolph	Indiana
	315	S79IN-65-2	Henry	Indiana
	316	S76IN-109-23	Morgan	Indiana
	317	S80IN-135-59	Randolph	Indiana
	318	S80IN-177-8	Wayne	Indiana
	319	S77IN-69-2	Huntington	Indiana
	320	S76IN-169-14	Wabash	Indiana
	321	S79IN-135-36	Randolph	Indiana

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Hennepin, Lewisburg, Strawn				
	322	S79IN-135-44	Randolph	Indiana
	323	S80IN-135-52	Randolph	Indiana
	324	S77IN-169-15	Wabash	Indiana
Hochheim				
	635	S68WI-15-1	Calumet	Wisconsin
	636	S68WI-15-2	Calumet	Wisconsin
Kidder				
	325	S71NH-125-001	Oakland	Michigan
	326	S90IL-111-004	McHenry	Illinois
Kidami				
	327	S90IL-111-004	McHenry	Illinois
	328	S71MI-125-001	Oakland	Michigan
	329	S90IL-111-001	McHenry	Illinois
	330	S92IL- 1 1 1-031	McHenry	Illinois
	331	S92IL-111-032	McHenry	Illinois
	332	S92IL-111-033	McHenry	Illinois
	333	S90IL-111-001	McHenry	Illinois
	658	S53WI-27-21	Dodge	Wisconsin
	676	S90IL-45-1	Edgar	Illinois
Kokomo				
	334	S78IN-177-11	Wayne	Indiana
	335	S81IN-007-010	Benton	Indiana
La Rose				
	336	S86IL-113-054	McLean	Illinois
	337	S89IL-113-009	McLean	Illinois
Lewisburg				
	338	S78IN-183-O1OD	Whitley	Indiana
	339	S87IN-183-010C	Whitley	Indiana
	340	S87IN-183-O1OA	Whitley	Indiana
	341	S87IN-183-010	Whitley	Indiana
	342	S87IN-183-000B	Whitley	Indiana
	343	S82IN-159-018	Tipton	Indiana
	344	S79IN-177-14	Wayne	Indiana
	345	MA-29	Madison	Indiana
	346	MA-32	Madison	Indiana
Locke				
	347	S71MI-099-001	Macomb	Michigan
	348	S71MI-087-003	Lapeer	Michigan
	349	S88MI-059-001	Hillsdale	Michigan
	350	S88MI-59-001	Hillsdale	Michigan

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Lowell				
	351	S60KY-049-006	Clark	Kentucky
	352	S60KY-049-005	Clark	Kentucky
	353	S60KY-049-003	Clark	Kentucky
	354	S60KY-049-002	Clark	Kentucky
	355	S75IN-29-6	Dearborn	Indiana
	356	S75IN-115-3	Ohio	Indiana
	357	JF-22	Jefferson	Ohio
McHenry				
	668	S92IL 111-035	McHenry	Illinois
	669	S92WI 027 024	Dodge	Wisconsin
	670	S54WI 027 010	Dodge	Wisconsin
	671	S54WI 027 023	Dodge	Wisconsin
Miami				
	358	S81IN-7-27	Benton	Indiana
	359	S76IN-31-33	Decatur	Indiana
	360	S78IN-31-1	Decatur	Indiana
	361	S79IN-73-28	Jasper	Indiana
	362	S76IN-87-5	LaGrange	Indiana
	363	S77IN-99-1	Marshall	Indiana
	364	S79IN-135-33	Randolph	Indiana
	365	S79IN-135-34	Randolph	Indiana
	366	S78IN-139-8	Rush	Indiana
	367	S77IN-169-17	Wabash	Indiana
	368	S78IN-177-7	Wayne	Indiana
	369	S78IN-177-8	Wayne	Indiana
	370	S78IN-65-4	Henry	Indiana
	371	S79IN-139-5	Rush	Indiana

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Miami				
	392	S82IL-011-187	Bureau	Illinois
	393	S83IL-039-008	De Witt	Illinois
	394	S83IL-039-008	De Witt	Illinois
	395	S82IL-011-187	Bureau	Illinois
	396	S81IN-183-002	Whitley	Indiana
	397	S84IN-157-024	Tippecanoe	Indiana
	398	S84IN-157-023	Tippecanoe	Indiana
	399	S84IN-157-022	Tippecanoe	Indiana
	400	S88MI-059-003	Hillsdale	Michigan
	401	S89MI-059-010	Hillsdale	Michigan
	402	S89MI-059-007	Hillsdale	Michigan
	403	S89MI-026-005	Cass	Michigan
	404	S89MI-026-001	Cass	Michigan
	405	S83IN-157-001	Tippecanoe	Indiana
	406	S87IN-107-008D	Montgomery	Indiana
	407	S87IN-107-008C	Montgomery	Indiana
	408	S87IN-107-008B	Montgomery	Indiana
	409	S87IN-107-008A	Montgomery	Indiana
	410	S87IN-107-008	Montgomery	Indiana
	411	S87IN-107-001	Montgomery	Indiana
	412	S82IN-107-017	Montgomery	Indiana
	413	S82IN-107-016	Montgomery	Indiana
	414	S82IN-107-015	Montgomery	Indiana
	415	S82IN-107-014	Montgomery	Indiana
	416	S82IN-107-013	Montgomery	Indiana
	417	S82IN-107-006	Montgomery	Indiana
	418	S82IN-107-005	Montgomery	Indiana
	419	S82IN-107-002	Montgomery	Indiana
	420	S82IN-107-001	Montgomery	Indiana
	421	S78IN-089-010	Lake	Indiana
	422	S78IN-089-009	Lake	Indiana
	423	S78IN-089-008	Lake	Indiana
	424	S78IN-089-007	Lake	Indiana
	425	S81IN-073-002	Jasper	Indiana
	426	S92IN-035-014	Delaware	Indiana
	427	S92IN-035-013	Delaware	Indiana
	428	S92IN-035-011	Delaware	Indiana
	429	S90IN-035-006	Delaware	Indiana
	430	S84IN-015-011	Carroll	Indiana
	431	S84IN-011-000	Boone	Indiana
	432	S81IN-011-016	Boone	Indiana
	433	S81IN-011-012	Boone	Indiana
	434	S81IN-011-006	Boone	Indiana
	435	S81IN-011-002	Boone	Indiana
	436	S92IL-111-033	McHenry	Illinois
	437	S92IL-111-031	McHenry	Illinois
	438	S92IL-111-032	McHenry	Illinois

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1/]	Sample Number	State or NSSL Number	County	State
Miami	442	S84IL-29-003	Coles	Illinois
	443	S84IL-29-109	Coles	Illinois
	444	S84IL-39-001	De Witt	Illinois
	445	S86IL-113-001	McLean	Illinois
	446	S86IL-113-004	McLean	Illinois
	447	S94IL-147-022	Piatt	Illinois
	448	S84IL-147-012	Piatt	Illinois
	449	S52IL-75-001	Iroquois	Illinois
Miamian				
	450	S88OH-113-005	Montgomery	Ohio
	451	S88OH-113-004	Montgomery	Ohio
	452	S88OH-113-003	Montgomery	Ohio
	453	S88OH-113-002	Montgomery	Ohio
	454	S88OH-113-001	Montgomery	Ohio
	455	S92IN-035-010	Delaware	Indiana
	456	S92IN-035-009	Delaware	Indiana
	457	S92IN-035-008	Delaware	Indiana
	458	S81IN139-1	Rush	Indiana
	459	S82IN53-7	Grant	Indiana
	460	PY-23	Pickaway	Ohio
	461	MT-23	Montgomery	Ohio
	462	HA-7	Hamilton	Ohio
	662	DK-15	Darke	Ohio
	663	DK-6	Darke	Ohio
	664	DK-29	Darke	Ohio
Millsdale				
	463	S76IN-169-11	Wabash	Indiana
	464	S77IN-31-5	Decatur	Indiana
	465	S79IN-139-8	Rush	Indiana
	466	S78IN-89-4	Wayne	Indiana
	467	S77IN-69-7	Huntington	Indiana
	468	PB-45	Preble	Ohio
	469	OT-7	Ottawa	Ohio
Milton				
	470	S76IN-31-34	Decatur	Indiana
	471	S78IN-139-15	Rush	Indiana
	472	WA-46	Warren	Ohio
	473	WA-47	Warren	Ohio

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1/]	Sample Number	State or NSSL Number	County	State
Morley				
	484	S94IN-035-005	Delaware	Indiana
	485	S84IL-183-112	Vermilion	Illinois
	486	S13020-SS13022	Hancock	Ohio
	487	S82IL-11-076	Bureau	Illinois
	488	S84IL-147-012	Piatt	Illinois
	489	S63IL-43-001	Du Page	Illinois
	490	S68IL-43-001	Du Page	Illinois
	491	S74IL-43-001	Du Page	Illinois
	492	S77IL-19-032	Champaign	Illinois
	493	S77IL-85-038	Jo Daviess	Illinois
	494	S79IN-135-35	Randolph	Indiana
	495	S79IN-135-50	Randolph	Indiana
	496	S79IN-9-6	Blackford	Indiana
	497	S78IN-85-3	Kosciusko	Indiana
	498	S78IN-135-4	Randolph	Indiana
	499	S80IN-183-9	Whitley	Indiana
	500	S80IN-1-3	Adams	Indiana
	501	S78IN-3-2	Allen	Indiana
	502	S80IN-49-4	Fulton	Indiana
	503	S82IN-53-3	Grant	Indiana
	504	S80IN-75-5	Jay	Indiana
	505	S84IN-179-4	Wells	Indiana
	506	WE8509	Wells	Indiana
	507	S80IN-1-3	Adams	Indiana
	508	S85IN-179-006	Wells	Indiana
	509	HK-19	Hancock	Ohio
	510	HK-28	Hancock	Ohio
	511	SH-17	Shelby	Ohio
	512	WL-26	Williams	Ohio
	623	S59IN-35-1	Delaware	Indiana
	624	S55IN-3-18	Allen	Indiana
	625	S55IN-3-17	Allen	Indiana
	665	S89MI-26-1	Cass	Michigan
	666	S89MI-26-5	Cass	Michigan
Octagon				
	477	S79IN-73-20	Jasper	Indiana
	478	S79IN-73-21	Jasper	Indiana
	479	S 80IN-107-4	Montgomery	Indiana
	622	S83IN-111-14	Newton	Indiana
Odell				
	513	S85IN-111-013	Newton	Indiana
	514	S82IN-073-018	Jasper	Indiana
	515	S75IL-75-004	Iroquois	Illinois
	516	S83IL-53-013	Ford	Illinois
	517	S76IL-19-043	Champaign	Illinois
	518	S80IN-73-25	Jasper	Indiana

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Ozaukee				
	519	S58WI-131-001	Washington	Wisconsin
	520	S58WI-089-001	Ozaukee	Wisconsin
	521	S58WI-101-004	Racine	Wisconsin
	522	S58WI-059-003	Kenosha	Wisconsin
	667	S84IL-183-112	Vermillion	Illinois
Parr				
	523	S79IN-73-22	Jasper	Indiana
	524	S80IN-107-1	Montgomery	Indiana
	525	S80IN-73-28	Jasper	Indiana
	526	WA-19	Warren	Ohio
	527	S82IN-107-004	Montgomery	Indiana
	528	S82IN-107-003	Montgomery	Indiana
	529	S90IL-139-002	Moultrie	Illinois
	530	S90IL-045-004	Edgar	Illinois
	531	S83IL-011-067	Bureau	Illinois
Pewamo				
	532	S68MI-155-001	Shiawassee	Michigan
	533	S68MI-037-001	Clinton	Michigan
	534	S89MI-026-002	Cass	Michigan
	535	S84IN-179-008	Wells	Indiana
	536	S84IN-075-001	Jay	Indiana
Pewamo				
	537	S94IN-035-11	Delaware	Indiana
	538	S94IN-035-10	Delaware	Indiana
	539	S94IN-035-7	Delaware	Indiana
	540	S91IN-035-007	Delaware	Indiana
	541	S79IN-1-1	Adams	Indiana
	542	S80IN-183-14	Whitley	Indiana
	543	S78IN-1-7	Adams	Indiana
	544	S79IN-9-5	Blackford	Indiana
	545	S79IN-33-1	De Kalb	Indiana
	546	S77IN-69-5	Huntington	Indiana
	547	S78IN-135-16	Randolph	Indiana
	548	S80IN-49-8	Fulton	Indiana
	549	S80IN-1-4	Adams	Indiana
	550	S80IN-53-4	Grant	Indiana
	551	S80IN-1-4	Adams	Indiana
	552	S84IN-179-008	Wells	Indiana
	553	HK-24	Hancock	Ohio
	554	HK-11	Hancock	Ohio
Raub				
	555	S86IN-157-13	Tippecanoe	Indiana

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Rawson				
	556	S83IN-183-002	Whitley	Indiana
	557	S79IN-1-2	Adams	Indiana
	558	S79IN-33-3	De Kalb	Indiana
	559	S78IN-69-3	Huntington	Indiana
	560	S76IN-169-7	Wabash	Indiana

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series [1]	Sample Number	State or NSSL Number	County	State
Toronto				
	595	S80IN-107-17	Montgomery	Indiana
	596	S84IN-157-32	Tippecanoe	Indiana
	652	S83IL-29-56	Coles	Illinois
	653	S83IL-29-72	Coles	Illinois
	654	S61IL-19-2	Champaign	Illinois
	655	S61IL-147-2	Piatt	Illinois
	656	S83IL-29-102	Coles	Illinois
Varna				
	597	S58WI-101-002	Racine	Wisconsin
	598	S58WI-101-001	Racine	Wisconsin
	599	S90IL-111-002	McHenry	Illinois
	600	S76IN-181-29	White	Indiana
	623	S59IN-69-1	Huntington	Indiana
	624	S55IN-3-18	Allen	Indiana
	625	S55IN-3-17	Allen	Indiana
	665	S89MI-25-1	Calhoun	Michigan
	666	S89MI-25-5	Calhoun	Michigan
	649	S69IN-63-3	Hendricks	Indiana
	650	S76IN-31-16	Decatur	Indiana
	651	S90IL-45-1	Edgar	Illinois
	652	S83IL-29-56	Coles	Illinois
	653	S83IL-29-72	Coles	Illinois
	654	S61IL-19-2	Champaign	Illinois
	655	S61IL-147-2	Piatt	Illinois
	656	S83IL-29-102	Coles	Illinois
Williamstown				
	639	S91IN-35-3	Delaware	Indiana
	640	S93IN-39-1	Elkhart	Indiana
	641	S89MI-59-5	Hillsdale	Michigan
	642	S89MI-59-11	Hillsdale	Michigan
	643	S89MI-59-2	Hillsdale	Michigan
Wolcott				
	657	S84IN111-25	Newton	Indiana
Xenia				
	601	S83IL-183-024	Vermilion	Illinois
	602	S83IL-147-035	Piatt	Illinois
	603	S90IL-139-004	Moultrie	Illinois
	604	S81IL-115-049	Macon	Illinois
	605	S90IL-045-002	Edgar	Illinois
	606	S82IL-029-027	Coles	Illinois
	607	S61IL-019-001	Champaign	Illinois
	608	S85IL-173-011	Shelby	Illinois
	609	WA-SI4	Warren	Ohio
	610	BR-3	Butler	Ohio
	611	WA-70	Warren	Ohio

Table 1. Sample locations of till soils used to develop series concepts for soils in Land Resource Region M—Continued

Soil Series 1/	Sample Number	State or NSSL Number	County	State
Xenia				
	612	BR-15	Butler	Ohio
	613	S76IN-31-7	Decatur	Indiana
	614	S78IN-139-17	Rush	Indiana
	615	S80IN-107-21	Montgomery	Indiana
	616	S78IN-89-2	Wayne	Indiana
	617	S69IN-63-4	Hendricks	Indiana
	618	S76IN-31-10	Decatur	Indiana
	619	S80IN-107-21	Montgomery	Indiana
	620	S78IN-89-2	Wayne	Indiana
	621	S76IN-31-7	Decatur	Indiana
	622	S83IN-111-14	Newton	Indiana

1/ Name listed with data before 1996.

Table 2. Particle size [1] and carbonate data and calculated bulk density for the Miami soil suite C or Cd horizons

Sample number	Clay %	Silt %	Sand %	C.S. %	V.C.S. %	CCE [2] %	>2mm [3] %	B.D.[4] @ 0.3 bar g cm^{-3}
113	21	44	35	6.2	8.4	32	10	1.77
115	19	46	35	6.5	7.3	37	23	1.79
140	15	39	46	6.1	6.1	24	1	1.85
148	18	46	36	8.1	3.6	26	10	1.81
155	28	51	21	5.1	5.2	14	6	1.68
156	24	42	33	3.4	2.4	32	7	1.73
157	21	42	37	4.3	4.2	28	7	1.77
158	12	37	51	5.9	4.6	12	14	1.89
164	19	42	39	4.3	2.7	28	5	1.79
165	22	45	33	3.9	2.5	33	6	1.76
166	13	42	45	6.5	5.3	43	24	1.87
167	27	37	37	3.8	3.1	25	11	1.69
169	20	44	36	3.6	2.9	23	1.1	1.78
170	26	47	28	4.3	2.7	18	10	1.70
172	22	47	31	4.9	2.6	45	9	1.76
173	15	38	47	7.8	4.6	28	0.5	1.85
174	12	36	52	8.2	4.7	29	7	1.89
175	21	45	33	3.3	2.5	29	2	1.77
177	16	38	46	6.1	3.3	37	0.5	1.83
179	13	34	53	10.7	10.3	35	25	1.87
180	17	39	44	6.4	4.7	42	17	1.82
312	21	45	34	5.5	3.7	46	8	1.77
313	22	42	36	5.4	4.3	42	14	1.76
314	13	42	45	6.2	5.1	42	23	1.87
315	24	41	35	4.1	3.1	33	8	1.73
316	24	43	33	4.1	1.6	15	0.5	1.73
317	19	39	42	7.1	5.1	36	24	1.79
344	19	42	39	6.9	3.7	46	0.5	1.79
358	16	43	41	5.8	3.4	26	0.5	1.83
359	28	48	24	2.5	1.5	12	2	1.68
360	14	33	53	9.2	6.7	31	23	1.86
365	28	17	55	11.1	9.5	6	21	1.68
366	19	42	39	5.8	6.4	40	10	1.79
368	16	39	46	6.9	3.9	43	19	1.83
369	14	39	47	7.1	5.8	46	19	1.86
370	18	38	44	5.4	3.5	26	17	1.81
371	13	33	54	6.7	5.1	34	27	1.87
372	19	42	39	5.1	3.9	44	11	1.79
373	21	44	35	4.4	3.2	26	4	1.77
374	13	45	42	6.4	4.3	37	23	1.87
379	14	39	47	5.4	4.1	37	37	1.86
380	22	44	35	5.4	3.1	36	0.5	1.76
381	17	40	43	4.6	4.5	32	10	1.82
382	22	47	31	4.6	4.3	22	4	1.76
383	21	40	38	5.1	5.7	23	7	1.77
384	9	29	62	8.3	8.6	33	23	1.92
396	15	31	54	6.1	4.2	29	13	1.85
400	14	38	48	4.7	4.6	29	0.5	1.86
405	10	33	57	7.6	6.7	35	15	1.91
410	14	23	63	7.9	5.1	23	9	1.86

Table 2. Particle size [1] and carbonate data and calculated bulk density for the Miami soil suite C or Cd horizons —Continued

Sample	Clay	Silt	Sand	C. S.	V.C.S.	CCE [2]	>2mm [3]	B.D. [4] @ 0.3 bar

Table 3. Bulk density and other data for the Miami soil suite C or Cd horizons

Sample number	Depth cm	Ratio 15 bar to clay	B.D. @ 0.3 bar g cm^{-3}	--- Pore volume ---- Drained %	Filled %	K_2O [1/] In <0.002 mm clay
166	145-185	0.53	1.91	3	20	2.7
167	85-150	0.40				
381	130-150	0.55	1.72	8	25	
382	130-150	0.46				
383	100-150	0.50				
396	150-155	0.37		8	42	
397	95-130		1.87	4	22	
398	90-125		1.81	7	18	
399	105-130		1.87	4	22	
404	130-160	0.39	1.91	7	18	2.5
410	130-165	0.40	1.98	3	20	3.3
412	50-65		1.81	3	27	
413	110-120		1.81	3	27	
415	95-125		1.88	2	25	

Table 4. Particle size and carbonate data and calculated bulk density data for the Kidami soil suite C horizons

Sample number	Clay %	Silt %	Sand %	C.S. %	V.C.S. %	CCE [1/] %	B.D. [2/] @ 0.3 bar g cm^{-3}
150	18	33	49	4.1	3.8	22	1.81
151	26	48	26	2.1	0.8	26	1.70
187	25	38	47				1.72
188	35	47	18	1.3	0.6		1.59
309	20	49	31	3.8	2.6	14	1.78
310	29	39	32	3.1	2.7	22	1.67
329	16	46	38	2.3	1.8	33	1.83
330	18	38	44	3.8	2.3	32	1.81
331	17	43	40	2.6	2.2	38	1.82
332	13	40	47	4.1	2.6	38	1.87
361	15	43	42	4.6	2.9	27	1.85
362	13	43	44	4.4	2.3	26	1.87
363	11	38	51	6.7	3.4	27	1.90
367	17	49	34	3.5	2.6	26	1.82
377	20	45	35	3.2	2.1	21	1.78
389	20	35	45	5.2	4.2	25	1.78
401	15	41	44	4.7	3.4	26	1.85
402	18	44	38	4.1	3.6	38	1.81
425	14	46	40	3.9	3.5	28	1.86
523	18	40	42	3.3	2.3	8	1.81
525	15	47	37	4.3	2.6	25	1.85
529	23	45	33	3.1	1.6	16	1.74
530	17	42	43	4.3	3.1	15	1.82
579	21	48	31	5.7	5.2		1.77
Mean	19.5	40.5	40	4.9	4.5	22	1.79
Count	24	24	24	23	23	21	24
Std. Dev.	2.1	10.6	12.7	1.1	1.0	5.0	0.027

1/ Calcium carbonate equivalent. Carbonate was not removed before particle size analysis.
2/ Bulk density at 0.3 bar is estimated by the model B.D. = 2.04 – 0.0129 x % clay, r^2 = 0.55, n = 110, SE = 0.11. See appendix.

Table 5. Bulk density and other data for the Kidami soil suite C horizons

Sample number	Depth cm	Ratio 15 bar	D.B.@ 0.3 bar to clay	---- Pore volume ----- Drained g cm^{-3}	Filled %	K_2O [1/] In <0.002 mm % clay
150	130-165	0.39	1.90	4	23	
151	85-150	0.42				
309	50-70	0.47	1.65	12	24	
329	135-170	0.35	1.89	4	23	2.7
330	135-150	0.41				
331	135-150	0.42				
529	145-175	0.45		9	45	0.7
530	125-165	0.44	1.76	1	31	4.1
633	130-190	0.48	1.89	3	26	3.6
Mean		0.46	1.83	6	28	2.8
Count		10	7	7	7	4
Std. Dev.		0.042	0.086	3.8	8.0	1.50

1/ The percent mica is reported to be equal to 10 times the K_2O content (Jackson 1956).

Table 6. Particle size and carbonate data and calculated bulk density data for the Morley soil suite C or Cd horizons

Sample number	Clay %	Silt %	Sand %	C.S. %	V.C.S. %	CCE[1/] %	>2mm[2/] %	B.D.[3/]@ 0.3 bar g cm^{-3}
45	33	44	23	2.8	1.9	30	16	1.61
51	42	40	18	2.3	1.9	23	4	1.50
55	40	40	20	3.3	2.1	18	4	1.52
56	37	42	21	2.8	2.1	24		1.56
57	33	44	23	2.8	1.9	30	17	1.61
58	36	45	19	2.9	2.3	32		1.58
59	31	44	25	4.3	4.1	24		1.64
60	31	46	23	4.1	4.2	24		1.45
61	32	46	22	3.3	3.4	30	5	1.45
62	36	43	21	2.9	2.6	27	6	1.49
63	35	44	21	3.2	1.9	20	3	1.47
64	34	47	19	3.4	1.7	24	3	1.43
68	35	44	21	3.2	1.9	16	3	1.47
69	31	45	24	2.8	2.1	31	4	1.46
70	27	48	25	3.4	3.1	31	11	1.42
71	36	43	21	2.9	2.6	27	6	1.49
73	39	44	17	2.2	1.2	23		1.47
75	27	45	28	3.9	2.9	31	4	1.46
76	38	43	19	2.5	2.4	27	6	1.49
78	31	47	22	2.8	1.7	28		1.43
79	24	46	30	3.6	2.1	39	10	1.45
83	30	43	27	2.9	2.4	23		1.49
279	27	49	27	2.1	1.1	23		1.41
280	31	47	22	2.1	1.1	25		1.43
288	34	46	20	2.3	2.9	32	5	1.45
293	37	43	20	2.2	1.1	31	1	1.49
294	32	45	23	3.3	2.1	37	1	1.46
295	33	46	21	3.1	2.1	18	6	1.45
296	26	48	26	3.9	2.2	30	14	1.42
297	31	44	25	3.8	3.3	31	18	1.47
298	32	44	24	4.2	3.8	37	7	1.47
299	37	42	21	1.9	1.3	23		1.50
301	34	25	41	5.7	2.3	7		1.72
302	32	44	24	4.2	4.9	24	11	1.47
303	32	47	21	4.9	2.7	19	3	1.43
304	33	46	21	3.1	2.1	16	6	1.45
305	41	42	17	2.7	2.8	16	15	1.50
306	40	41	19	2.7	1.5	19	4	1.51
481	29	34	37	1.1	0.8	18	5	1.60
486	23	49	28	4.5	3.7	25		1.41
494	28	60	12	1.8	0.8	37	2	1.27
497	34	40	26	2.2	1.3	20	7	1.52
498	25	46	29	3.1	2.4	19	5	1.45
499	32	42	26	2.8	2.8	24	1	1.50
500	32	46	22	3.4	1.9	25	12	1.45
501	39	51	10	1.2	0.8	12	4	1.38
502	29	44	27	3.1	2.8	28	4	1.47
503	34	42	24	3.2	2.1	33	6	1.50

Table 6. Particle size and carbonate data and calculated bulk density data for the Morley soil suite C and Cd horizons—Continued

Sample number	Clay %	Silt %	Sand %	C.S. %	V.C.S. %	CCE [1/] %	>2mm [2/] %	B.D. [3/] @ 0.3 bar g cm^{-3}
507	32	46	22	3.4	1.9	25	12	1.45
508	36	43	21	2.4	1.9	25		1.49
509	41	38	21	3.1	1.9	23		1.55
510	39	41	20	3.1	2.5	18		1.51
512	37	46	17	2.4	2.2	32		1.45
623	30	46	24	3.4	2.8	24	6	1.45
624	37	43	20	2.3	3.1	19	8	1.49
625	38	42	20	3.4	2.8	13	3	1.50
632	38	45	17	1.9	2.5		8	1.46
648	36	48	16	2.7	1.6	27	8	1.42
665	40	43	17	0.8	0.7	17	2	1.49
666	31	47	22	1.2	0.9	19	2	1.43
Mean	33.5	44.2	22.4	3.0	2.2	24.8	6.8	1.48
Count	62	62	62	62	62	61	45	62
Std. Dev.	1.41	2.12	0.71	1.13	0.71	7.78	9.90	0.127

1/ Calcium carbonate equivalent. Carbonate was not removed before particle size analysis.
2/ Weight basis.
3/ Bulk density at 0.3 bar is estimated by the model B.D. = 2.04 – 0.0129 x % clay, r^2 = 0.55, n = 110, SE = 0.11. See appendix.

Table 7. Bulk density and other data for the Morely soil suite C or Cd horizons

Sample number	Depth cm	Ratio 15 bar to clay	B.D.@ 0.3 bar to cm^3	. . . Pore volume. . . . Drained %	Filled %	K_2O [1/] In <0.002 mm %
48	90-100	0.38	1.84	0	30	
51	120-135	0.43	1.75	1	32	4.0
481	60-150	0.41				
Mean		0.41	1.80	1	31	
Count		2	2	2	2	
Std. Dev.		0.025	0.064	0.7	1.4	

1/ The percent mica is reported to be equal to 10 times the K_2O content (Jackson 1956).

Table 8. Particle size and calcium carbonate equivalent data and calculated bulk density data for the Ozaukee soil suite C or Cd horizons

Sample number	Clay %	Silt %	Sand %	C.S. %	V.C.S. %	CCE [1/] %	>2mm [2/] %	B.D. [3/] @ 0.3 bar g cm^{-3}
121	30	56	14					1.65
123	28	51	21	3.1	1.7			1.68
124	30	53	18	2.5	1.7			1.65
125	26	59	15	2.4	1.8			1.70
126	28	60	13					1.68
127	26	59	15	2.2	2.6			1.70
128	27	58	15	2.6	2.3			1.69
129	26	60	14	1.9	1.7			1.70
130	25	61	14					1.72
131	32	59	10					1.63
132	42	51	7					1.50
191	31	53	16	1.8	1.1	18	5	1.64
193	36	58	6	0.9	0.7	20	1	1.58
194	25	66	10					1.72
204	34	58	8					1.60
205	27	58	16					1.69
206	30	51	19	3.1	2.7			1.65
208	27	61	13					1.69
209	31	65	4					1.64
212	38	54	8					1.55
213	34	54	12					1.60
214	35	55	10					1.59
215	33	63	4					1.61
216	39	51	11					1.54
219	38	50	11					1.55
225	29	52	18					1.67
226	40	51	9					1.52
492	37	50	13					1.56
494	28	60	12	1.8	0.7	37	2	1.68
501	39	52	10	1.2	0.8	12	4	1.54
511	35	62	4	0.8				1.59
519	31	54	15	1.7	1.5	48		1.64
521	40	58	2	0.2	0.1	27		1.52
522	26	54	20	1.5	1.1	33		1.70
578	30	55	15	2.7	1.8	20	3	1.65
580	25	58	17	2.6	0.7			1.72
598	27	53	21	3.3	3.6	30		1.69
600	28	57	15	2.9	1.5	21		1.68
Mean	31.4	56.3	12.5	2.1	1.6	26.6	3	1.64
Count	38	38	38	19	18	10	5	38
Std. Dev.	5.03	4.31	4.86	0.86	0.86	10.67	1.58	0.065

1/ Calcium carbonate equivalent. Carbonate was not removed before particle size analysis.
2/ Weight basis.
3/ Bulk density at 0.3 bar is estimated by the model B.D. = 2.04 - 0.0129 x %clay, r^2 = 0.55, n = 110, SE = 0.11. See appendix.

Table 9. Bulk density and other data for the Ozaukee soil suite C or Cd horizons

Sample number	Depth cm	Ratio 15 bar to clay	B.D. 1/ g cm^{-3}
[redacted]			
422	135-165		1.96
423	130-165		2.04
424	140-175		2.09
519	85-115	0.39	1.82
520	60-90	0.37	1.97
521	95-115	0.39	1.74
522	80-110	0.40	1.94
Mean		0.40	1.94
Count		5	7
Std. Dev.		0.030	0.121

1/ The bulk densities are for field moist soil.

Table 10. Particle size and other data for C or Cd horizons of the Miamiam soil suite

Sample number	Depth cm	Clay %	Silt %	Sand %	V.F.S. %	F.S. %	M.S. %	C.S. %	V.C.S. g cm-3	CCE 1/ %	>2mm 2/ %
454	84-94	20.0	47.4	32.6	9.0	8.7	6.1	4.4	4.5	36	18
458	95-150	21.3	47.0	31.7	8.2	10.2	6.0	4.3	3.0	18	6
459	102-150	26.8	45.6	27.3	6.6	9.6	5.1	3.8	2.2	38	4
460	63-108	20.1	43.1	36.8	9.7	11.5	4.6	6.1	4.9	37	12
461	137-150	19.1	41.9	39.0	9.5	12.3	5.0	5.0	6.3	17	
662	128-150	20.3	40.1	39.6	9.9	10.8	6.6	7.3	5.0	38	
663	132-150	12.3	43.0	44.7	10.1	14.3	9.2	7.0	4.1	40	15
664	105-150	23.3	43.5	33.2	7.9	9.3	3.7	5.7	6.6	38	9
462	107-150	26.3	49.4	24.3	6.5	8.3	3.7	4.1	1.7	45	11
Mean		21.1	44.7	34.4	8.6	10.6	5.6	5.3	4.3	34.	11
Count		9	9	9	9	9	9	9	9	9	7
Std. Dev.		4.31	.09	6.37	38	1.19	70	1.29	1.70	1.48	4.89

1/ Calcium carbonate equivalent. Carbonate was not removed before particle size analysis.
2/ Weight basis.

Table 11. Particle size and other data for C or Cd horizons of the Kidder soil suite

Sample number	Depth cm	Clay %	Silt %	Sand %	V.F.S. %	F.S. %	M.S. %	C.S. %	V.C.S. g cm-3	CCE 1/ %	>2mm 2/ %
325	130-150	8.4	29.6	62.0	11.6	20.9	12.2	9.1	8.2	20	8
326	120-150	6.1	30.7	63.2	11.7	20.7	19.2	6.6	5.0	62	18
644	119-152	21.4	48.5	30.1	5.8	8.2	4.6	5.5	6.0	33	3
645	122-150	6.1	29.5	64.4	15.8	27.6	13.0	5.9	2.1	33	19
668	124-150	5.1	33.8	61.1	10.8	16.8	16.7	8.4	8.4	34	-
669	122-150	7.7	34.2	58.1	19.6	20.4	8.0	5.9	4.2	41	-
670	183-190	6.8	24.9	68.3	11.4	19.9	18.2	14.7	4.1	34	-
671	127-150	6.4	16.2	77.4	10.5	37.4	20.4	7.1	2.0	21	
Mean		8.5	30.9	60.6	5.0	21.5	14.0	7.9	5.0	35	12
Count		8	8	8	8	8	8	8	8	8	4

Table 12. Classification of the soil series used in the study [1/]

Soil Series	Soil Family
Alexandria	Fine, illitic, mesic Oxyaquic Hapludalfs
Amanda	Fine-loamy, mixed, active, mesic Typic Hapludalfs
Bennington	Fine, illitic, mesic Aeric Epiaqualfs
Birkbeck	Fine-silty, mixed, superactive, mesic Oxyaquic Hapludalfs
Blount	Fine, illitic, mesic Aeric Epiaqualfs
Brookston	Fine-loamy, mixed, superactive, mesic Typic Argiaquolls
Cardington	Fine, illitic, mesic Aquic Hapludalfs
Celina	Fine, mixed, active, mesic Aquic Hapludalfs
Chenoa	Fine, illitic, mesic Aquic Argiudolls
Condit	Fine, illitic, mesic Typic Epiaqualfs
Conover	Fine-loamy, mixed, active, mesic Udollic Endoaqualfs
Corwin	Fine-loamy, mixed, active, mesic Oxyaquic Argiudolls
Crosby	Fine, mixed, active, mesic Aeric Epiqualfs
Crosier	Fine-loamy, mixed, active, mesic Aeric Epiaqualfs
Dana	Fine-silty, mixed, superactive, mesic Oxyaquic Argiudolls
Dodge	Fine-silty, mixed, superactive, mesic Typic Hapludalfs
Elliott	Fine, illitic, mesic Aquic Argiudolls
Fincastle	Fine-silty, mixed, superactive, mesic Aeric Epiaqualfs
Flanagan	Fine, smectitic, mesic Aquic Argiudolls
Glynwood	Fine, illitic, mesic Aquic Hapludalfs
Graymont	Fine-silty, mixed, superactive, mesic Oxyaquic Argiudolls
Hayden	Fine-loamy, mixed, superactive, mesic Glossic Hapludalfs
Hennepin	Fine-loamy, mixed, active, mesic Typic Eutrudepts
Hochheim	Fine-loamy, mixed, mesic Typic Argiudolls
Kidami	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs
Kidder	Fine-loamy, mixed, active, mesic Typic Hapludalfs
Kokomo	Fine, mixed, superactive, mesic Typic Argiaquolls
La Rose	Fine-loamy, mixed, superactive, mesic Typic Argiudolls
Lewisburg	Fine, mixed, active, mesic, shallow Aquic Hapludalfs
Locke	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Lowell	Fine, mixed, active, mesic Typic Hapludalfs

Table 12. Classification of the soil series used in the study—Continued

Soil Series	Soil Family
McHenry	Fine-loamy, mixed, superactive, mesic Typic Hapludalfs
Miami	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs
Miamian	Fine, mixed, active, mesic Oxyaquic Hapludalfs
Millsdale	Fine, mixed, active, mesic Typic Argiaquolls
Milton	Fine, mixed, active, mesic Typic Hapludalfs
Morley	Fine, illitic, mesic Oxyaquic Hapludalfs
Octagon	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs
Odell	Fine-loamy, mixed, superactive, mesic Aquic Argiudolls
Ozaukee	Fine, illitic, mesic Oxyaquic Hapludalfs
Parr	Fine-loamy, mixed, aquic, mesic Oxyaquic Argiudolls
Pewamo	Fine, mixed, aquic, mesic Typic Argiaquolls
Raub	Fine-silty, mixed, superactive, mesic Aquic Argiudolls
Rawson	Fine-loamy, mixed, aquic, mesic Oxyaquic Hapludalfs
Russell	Fine-silty, mixed, superactive, mesic Typic Hapludalfs
Saybrook	Fine-silty, mixed, superactive, mesic Oxyaquic Argiudolls
Sidell	Fine-silty, mixed, mesic Typic Argiudolls
Strawn	Fine-loamy, mixed, active, mesic Typic Hapludalfs
Swygert	Fine, mixed, superactive, mesic Aquertic Argiudolls
Symerton	Fine-loamy, mixed, superactive, mesic Oxyaquic Arguidolls
Toronto	Fine-silty, mixed, superactive, mesic Udollic Epiaqualfs
Varna	Fine, illitic, mesic Oxyaquic Argiudolls
Williamstown	Fine-loamy, mixed, active, mesic Aquic Hapludalfs
Wolcott	Fine-loamy, mixed, mesic Typic Endoaquolls
Xenia	Fine-silty, mixed, superactive, mesic Aquic Hapludalfs

1/ Soils are classified according to *Soil Taxonomy* (Soil Survey Staff 1999).

Table 13. Multiple range tests for comparison of maximum clay contents in the Bt horizons of four of the six soil series and depths to maximum clay content of the Bt horizons 1/

Soil Series	Pedons: Total number	---- Maximum clay content in Bt Horizon ---- Means	Std. Dev.	Mini-mum	Maxi-mum	Homog-eneous Groups 2/	----- Depth to maximum Bt clay ----- Means	Std. Dev.	Homog-eneous Groups 2/
Morley	24	46.6	4.5	35.7	52.3	A	40.6	10.8	A
Miamian	10	38.4	3.8	35.3	46.9	B	36.9	15.2	A
Miami	21	33.5	3.1	25.5	39.9	C	52.3	18.6	B
Kidami	14	28.8	6.0	20.5	37.7	D	60.5	20.1	B

1/ Pedons were selected using the definitions of the series given in the section under Series Differentia. Note that those definitions apply to the till part of the series control section, not to the Bt horizon. The Ozaukee and Kidder series were not included in the analysis. There were only four pedons of Ozaukee and two of Kidder available.
2/ The multiple range test shows differences in means based on a 95% least significant difference. Series with the same letter are not significantly different at the 95% level.

Table 14. Multiple range test for comparison of parent material differences in the six suites of soils

Suites of soils	----------- Homogeneous Groups of soils for the named particle size fraction 1/ -----------					
	------- Coarse sand, 0.5–1.0 mm ------			Coarse and very course sand, 0.5–2.0 mm		
	Number	Means	Relationship 2/	Number	Means	Relationship 2/
Ozaukee	18	2.1	A	18	3.7	A
Morley	62	3.0	B	62	5.2	B
Kidami	23	3.8	C	23	6.5	C
Miamian	9	5.4	D	9	9.6	D
Miami	56	5.8	D	56	10.3	D
Kidder	6	8.6	E	6	14.0	E

1/ The multiple range test of the difference in means based on a 95% least significant difference. The pedons were selected using the definitions of the series given in the section under Series Differentia.
2/ Suites with the same letter are not significantly different at the 95% level.

Table 15. Comparison of clay and carbonate equivalent contents of the Bt and C or Cd horizons of the till-derived soils

Statistic	All drainage classes [1] Bt horizon Maximum clay %	Well and moderately well drained classes [2] -------- Bt horizons ------- Maximum clay %	Control section clay %	Basal till [1] ------- C or Cd horizon ------- Total clay %	Calcium carbonate equivalent %
Mean	38.7	38.0	36.5	33.8	28.0
Std. Dev.	8.74	9.0	8.8	12.2	9.1

1/ Data are for 153 samples of Bt horizons and the tills in the six suites of soils in all drainage classes. The clay data for both sets of samples are on a carbonate-free basis. Clay-size carbonate occurs in some of the Bt horizons. This was subtracted out in the calculations. We assumed that the remainder of the carbonate is in the silt and sand fractions. Clay content on a carbonate-free basis = [100 x (total clay - carbonate clay)]/[(sand + silt) - (total carbonate - carbonate clay) + (total clay - carbonate clay)].
2/ Data are for 99 samples of the six suites of soils that are in well and moderately well drained classes. The mean clay content of the Cd horizons of the 99 samples of the well and moderately well drained soils calculated on a carbonate-free basis is 32.3 ± 12.1 %. The mean carbonate content measured is 28.2 ± 9.2 %.

Table 16. Ranges in properties in the lower part of the series control section as determined by analysis of the National Soil Survey Laboratory data and ranges suggested for separating the suites of soils

Suites	Clay	Silt	Sand	V.F.S.	C.S.+ V.C.S.	C. Frags.	CCE [1]	B.D. @ 0.3 bar for the <2mm soil
	<.002mm	0.002–0.050 mm	0.05–2.0 mm	0.05–0.10 mm	0.5–1.0 mm	>2.0 mm	<2 mm	g cm^{-3}
	%	%	%	%	%	%	%	
Kidder	2<10	16–34	58-77	11-20	10-18	5-30	21-62	
Kidami	11-29	33-48	26-51	8-18	4-8	3-18	15-38	1.75-1.90
Miami	>12	>23<50	21-63	2-13	6-21	1-29	12-46	1.80-2.00
Miamian	>12-<27	40-49	24-45	6.5-9.9	6-13	8-18	36-45	1.39-1.52
Morley	27-42	40-49	17-30	1-7.5	2-8	3-37	16-30	1.75-1.85
Ozaukee	25-42	>50	4-21	1-6.5	2-7	1-5	20-48	1.80-2.10
Ranges in properties that can be used to separate the suites of soils.								
Kidder	<10	<34	>55	>10	≥9	>5	– [2]	– [2]
Kidami	10-28	<48	<55	>10	<10	3-18	–	–
Miami	12-<28	<50	<63	<13	>8	1-29	–	–
Miamian	12-<27	<50	<45	<10	>8	8-18	–	–
Morley	>27	<50	<30	<10	<8	3-37	–	–
Ozaukee	>25	>50	<21	<10	<8	<5	–	–

1/ Calcium carbonate equivalent.
2/ No limits set.

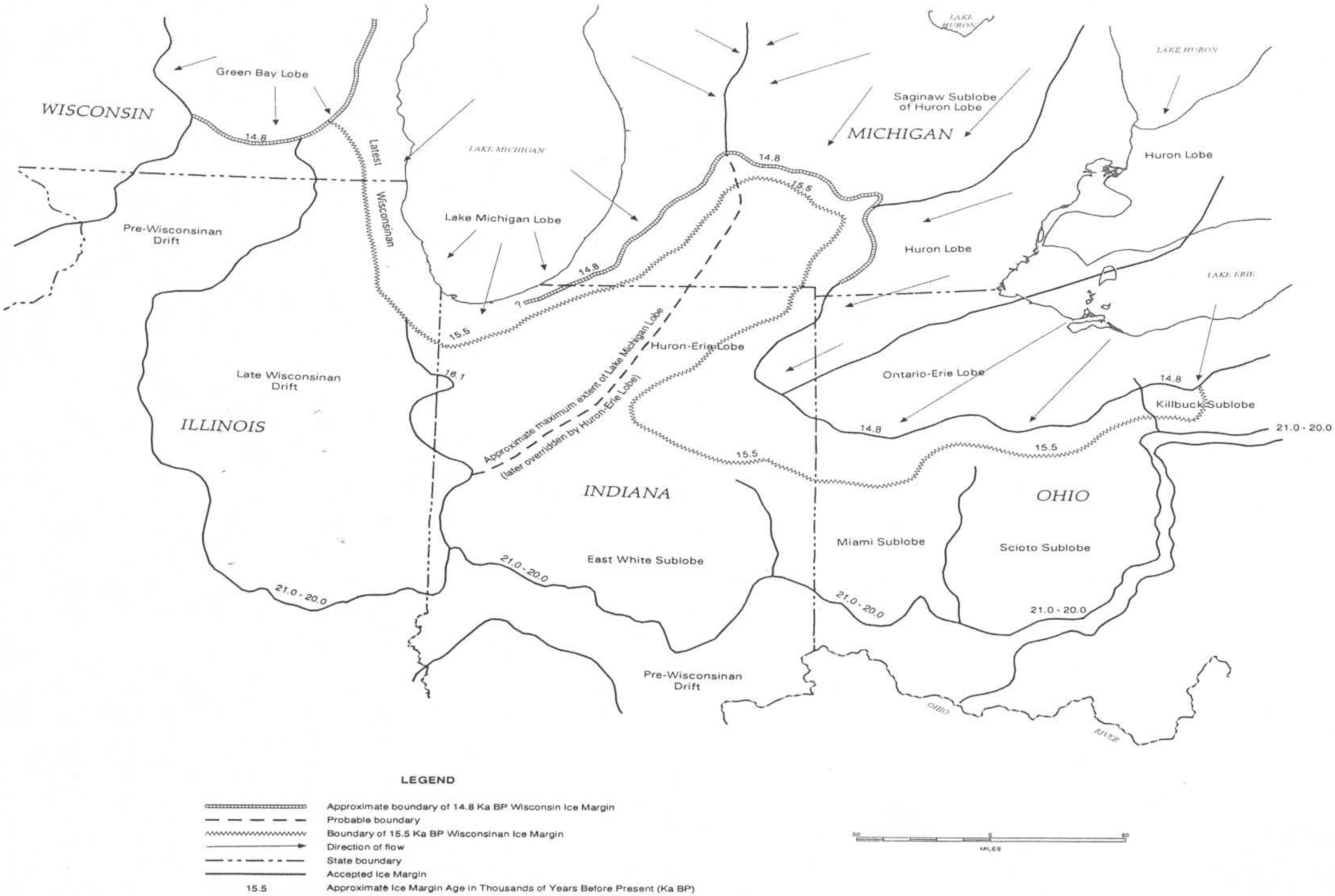


Figure 1. Composite map of the eastern part of the late Wisconsin age glacial geology of Land Resource Region M after Johnson, W.H. (1986), and Fullerton, D.S. (1986)

gure 2. Soil suites on Wisconsin age till, five State area—Illinois, Indiana, Ohio, Michigan, and Wisconsin

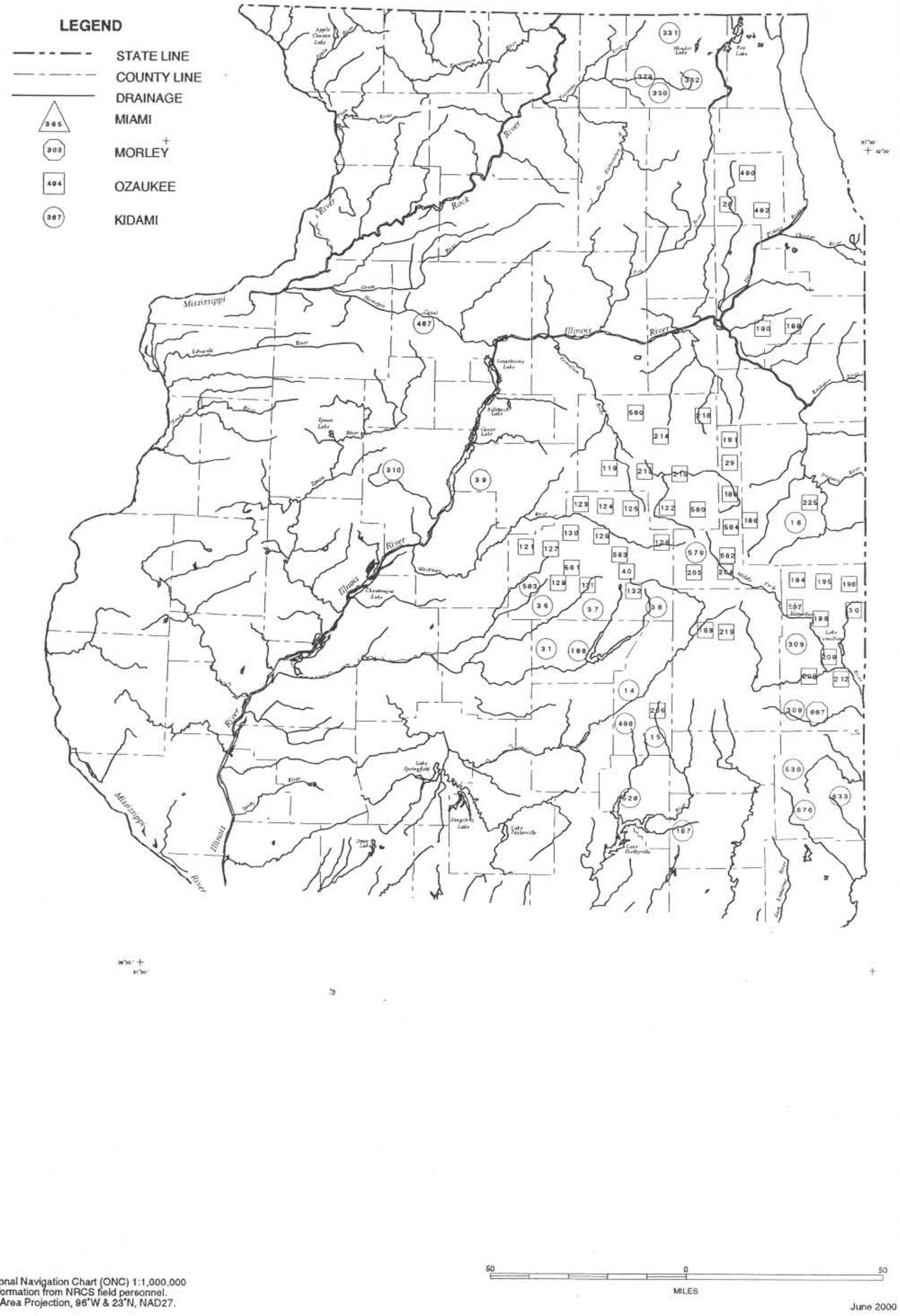


Figure 3. Map of the sample site locations in Illinois

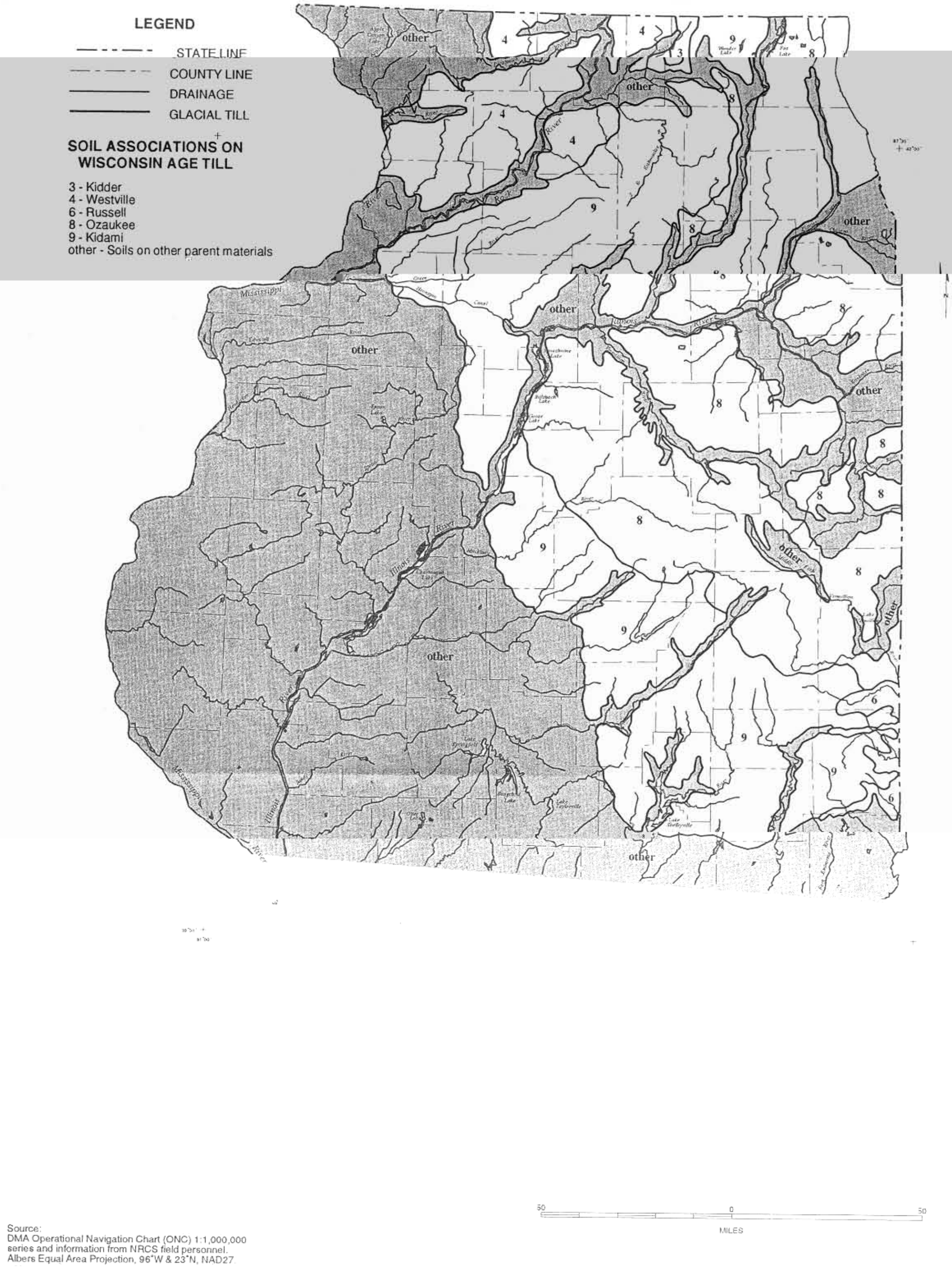
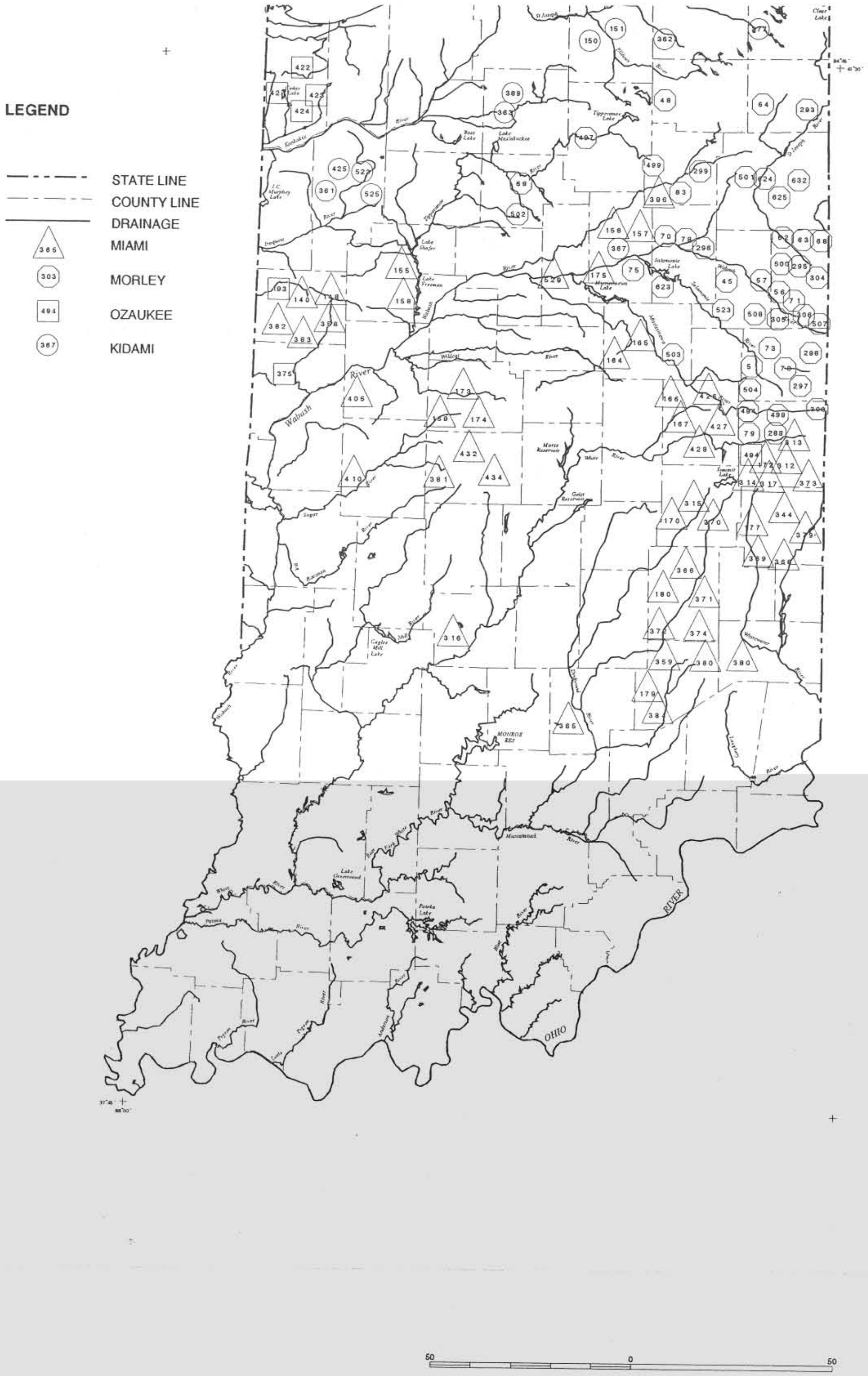


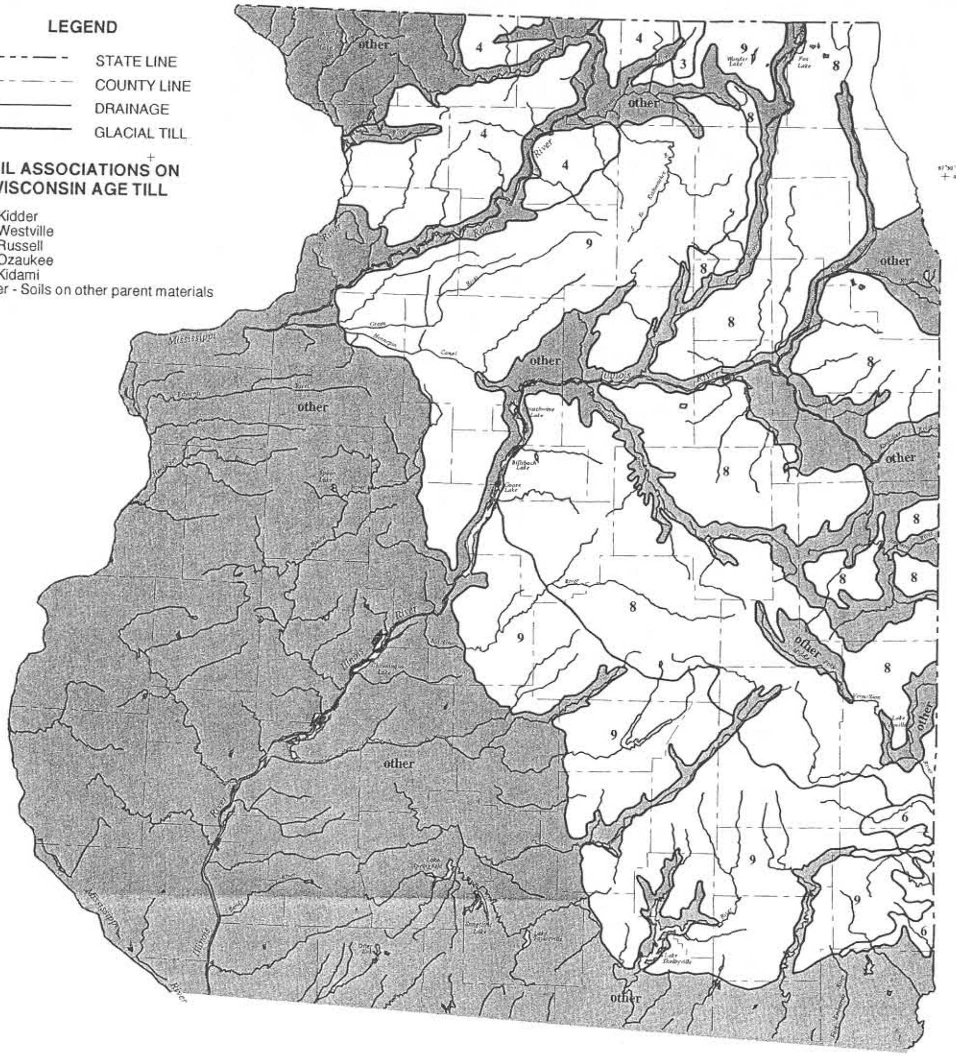
Figure 4. Map of the location of soil suites studied in Illinois

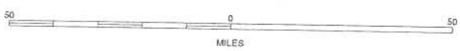


Source:
DMA Operational Navigation Chart (ONC) 1:1,000,000
series and information from NRCS field personnel.
Albers Equal Area Projection, 96°W & 23°N, NAD27.

June 2000 1008226

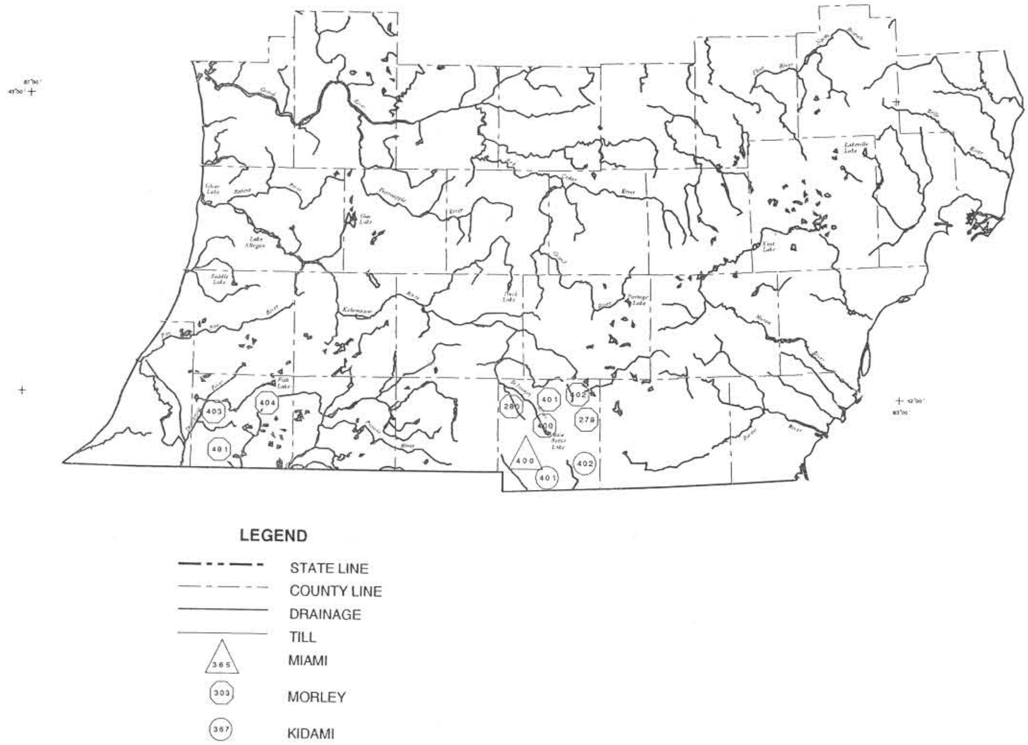
Figure 5. Map of the sample site locations in Indiana



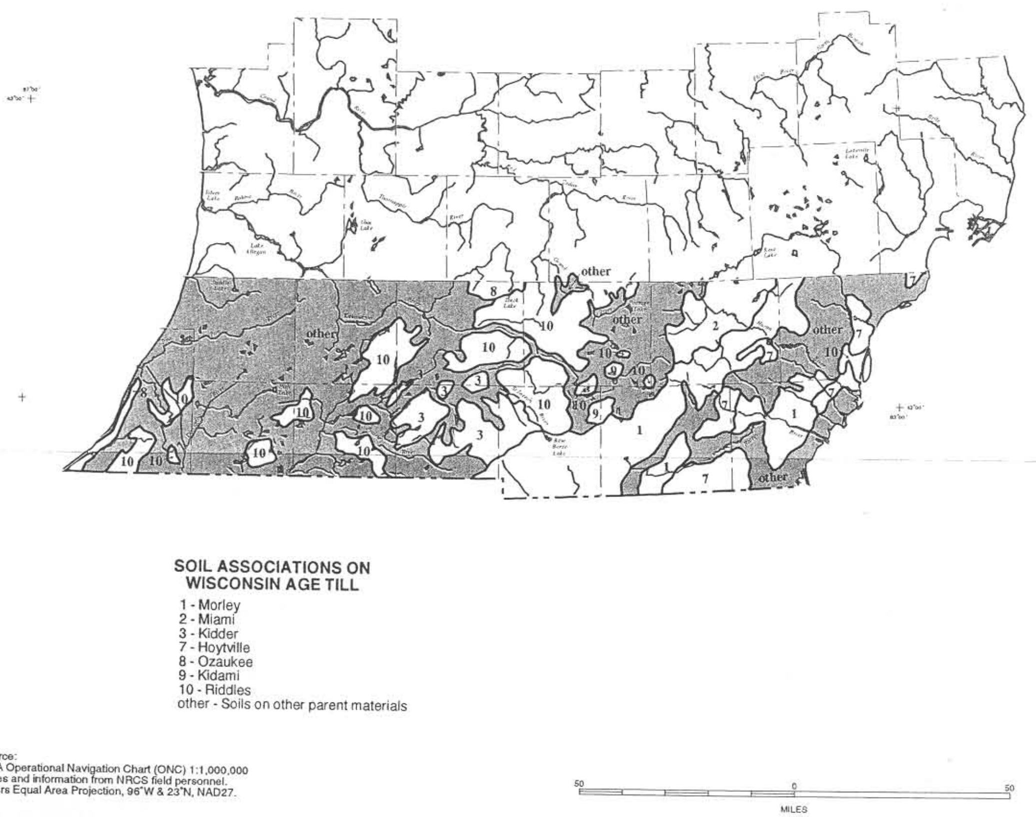


Source:
DMA Operational Navigation Chart (ONC) 1:1,000,000 series and information from NRCS field personnel.
Albers Equal Area Projection, 96°W & 23°N, NAD27.

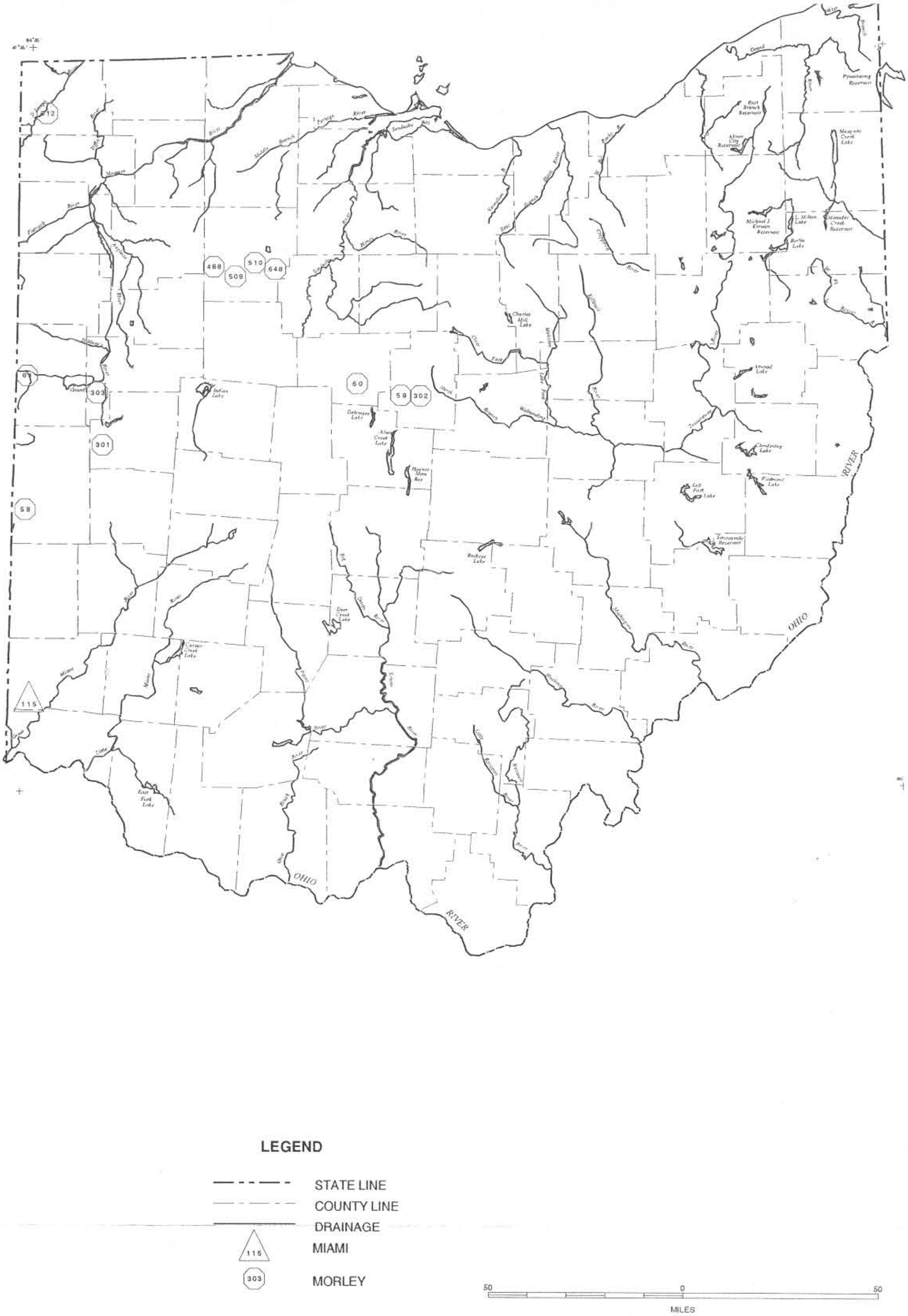
ure 6. Map of the location of soil suites studied in Indiana



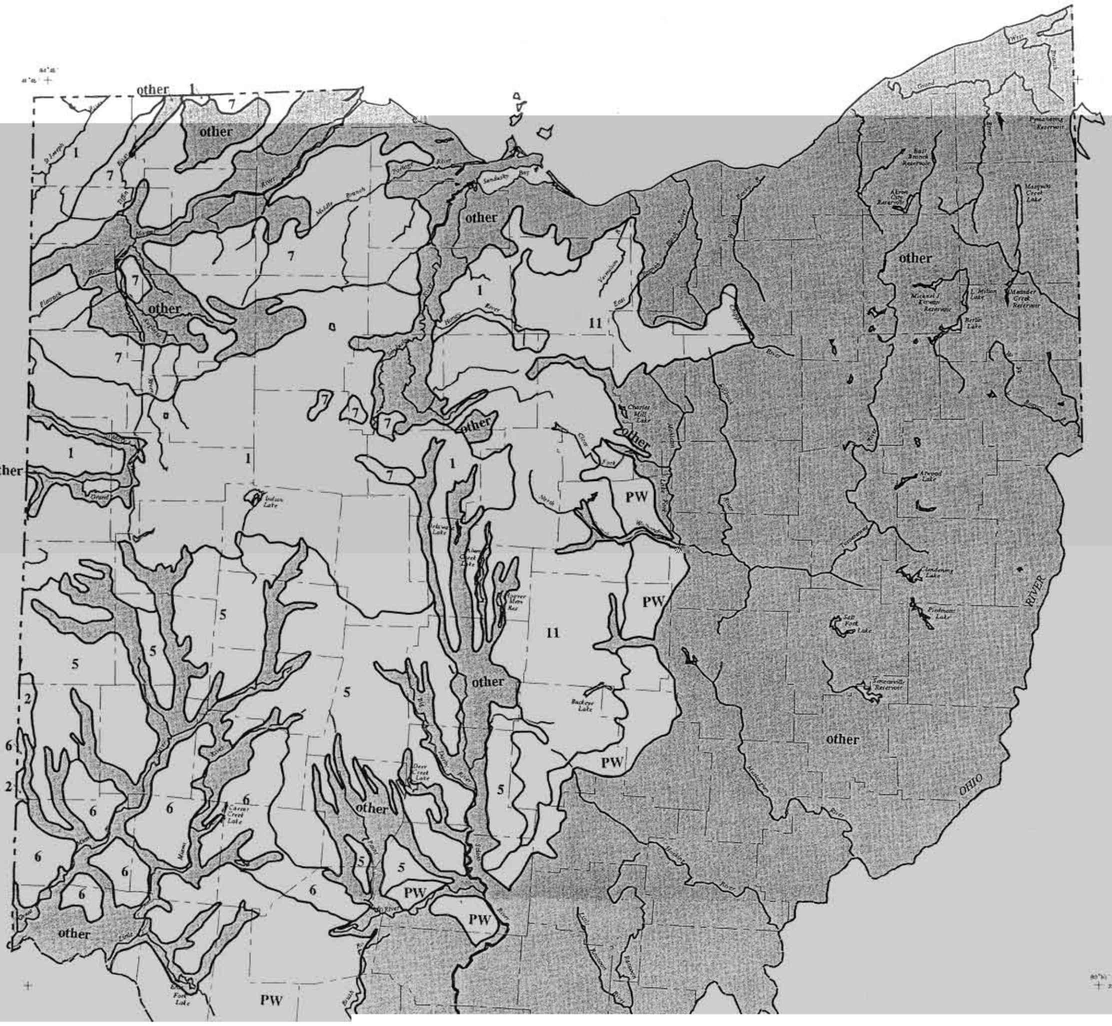
igure 7. Map of the sample site locations in southern Michigan



ure 8. Map of the location of soil suites studied in southern Michigan



gure 9. Map of the sample site locations in Ohio



other
1
7
11
PW
5
6
2
OHIO
RIVER

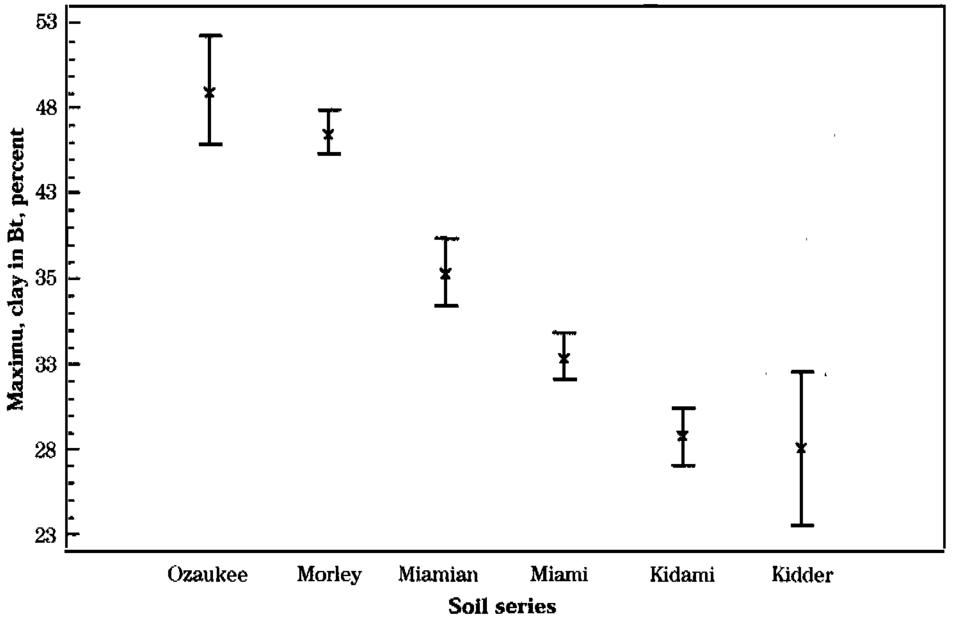


Figure 11. Plot of the mean and standard deviation of the maximum Bt horizon clay in the six soil suites